

## COLLEGE OF AGRICULTURE AND LIFE SCIENCES

### ADMINISTRATION

Daryl B. Lund, dean

Brian F. Chabot, associate dean

Rebecca Tseng Smith, assistant dean for public affairs

H. Dean Sutphin, associate dean and director of academic programs

Donald R. Viands, associate director of academic programs

W. Ronnie Coffman, associate dean and director of research

Anthony M. Shelton, associate director of research

William B. Lacy, associate dean and director of cooperative extension

R. David Smith, associate director of cooperative extension

Norman T. Uphoff, director of international agriculture

James E. Haldeman, associate director of international agriculture

### Office of Academic Programs Staff

Counseling and advising: Lisa Ryan, Bonnie Shelley

Registrar: Mary Milks, Patricia Austic, Carol Lucas, Leora Tripodi

Admissions: Randy Stewart, Bonnie Comella, Laurie Gillespie, Jody Sanford

Career development: William Alberta, Amy Benedict-Martin, Sheri Mahaney

Minority programs: Catherine Thompson

### Department Chairs

Agricultural and biological engineering: M. F. Walter, Riley-Robb Hall

Agricultural, resource, and managerial economics: A. M. Novakovic, Warren Hall

Animal science: H. F. Hintz, Morrison Hall

Communication: C. J. Glynn, Kennedy Hall

Education: D. H. Monk, Kennedy Hall

Entomology: D. A. Rutz, Comstock Hall

Floriculture and ornamental horticulture: G. L. Good, Plant Science Building

Food science: D. Miller, Stocking Hall

Fruit and vegetable science: H. C. Wien, Plant Science Building

Natural resources: D. J. Decker, Fernow Hall

Plant breeding and biometry: E. D. Earle, Emerson Hall

Plant pathology: S. A. Slack, Plant Science Building

Rural sociology: D. L. Brown, Warren Hall

Soil, crop and atmospheric sciences: J. M. Duxbury, Emerson Hall

### College Focus

The College of Agriculture and Life Sciences provides educational programs that prepare men and women with technical, management, and leadership skills. The college's programs fall into three major areas:

- Science and technology
- Management
- Communication and education

The college focuses on a broad-based education for its students, and on a problem-solving and basic research program. The program is geared to the discovery and dissemination of knowledge for the purpose of advancing the food system, agriculture, nutrition, biological sciences, environmental quality, and community and rural development throughout New York State, the nation, and the world.

There are six primary areas of focus, developed in response to the needs of society, and representing agriculture and life sciences in their broadest and most dynamic meaning:

- Agriculture (production and marketing)
- Biological Sciences
- Community, Human and Rural Resources
- Environment
- Food and Nutrition
- International

### Facilities

The College of Agriculture and Life Sciences is located on the upper campus, up the hill from the central area of Cornell University, on land that was once part of the Ezra Cornell family farm.

Buildings around the area commonly known as the Ag Quad house classrooms, offices, and laboratories. Flanking them are the greenhouses, gardens, and research facilities. Nearby orchards, barns, field plots, forests, and streams extend as far as the Animal Science Teaching Research Center at Harford and the Agricultural Experiment Station at Geneva.

Roberts Hall serves as headquarters for the administrative units, including offices of the deans and directors of academic programs, research, and cooperative extension. Included in the Office of Academic Programs are the director and associate director, the Admissions Office, the Career Development Office, the Office of Counseling and Advising, Office of Minority Programs, and the Registrar.

Mann Library, with its extensive collections of materials in the agricultural and biological sciences, is at the east end of the Ag Quad. The student lounge and service center, known as the Alfalfa Room, and many of the college classrooms are in Warren Hall. Public computer facilities are available in Warren Hall, in Riley-Robb Hall, and in Mann Library.

### DEGREE PROGRAMS

The College of Agriculture and Life Sciences offers programs leading to the degrees of Bachelor of Science, Master of Science, and Doctor of Philosophy. Professional degrees include the Master of Professional Studies and the Master of Arts in Teaching. Some registered professional licensing and certification programs are also available.

Each curriculum in the college creditable toward a degree is registered with the New York State Education Board and is linked with the national Higher Education General Information Survey (HEGIS) codes for federal and state reporting.

### Graduate Degrees

Graduate study is organized by fields that generally coincide with the academic departments but may draw faculty from several disciplines in the various colleges of the university. The following graduate fields have primary affiliation in Agriculture and Life Sciences. Current directors of graduate studies are also listed.

Agriculture [M.P.S. (Agr.)], H. D. Sutphin, Roberts Hall

Agricultural and Biological Engineering, J. A. Bartsch, Riley-Robb Hall

Agricultural Economics, R. N. Boisvert, Warren Hall

Animal Breeding, E. J. Pollak, Morrison Hall

Animal Science, R. L. Quaas, Morrison Hall

\*Biochemistry, Molecular and Cell Biology; G. W. Feigenson, Biotechnology Building

Biometry, N. S. Altman, Warren Hall

Communication, M. A. Shapiro, Kennedy Hall

Development Sociology, P. McMichael, Warren Hall

\*Ecology and Evolutionary Biology, R. B. Root, Corson Hall

Education [also M.A.T.], J. D. Deshler, Kennedy Hall

Entomology, J. G. Scott, Comstock Hall

Environmental Toxicology, A. Yen, Rice Hall

Floriculture and Ornamental Horticulture, N. L. Bassuk, Plant Science Building

Food Science and Technology, J. H. Hotchkiss, Stocking Hall

\*Genetics and Development, M. F. Wolfner, Biotechnology Building

International Agriculture and Rural Development [M.P.S. (Agr.)], R. W. Blake, Morrison Hall

International Development, N. T. Uphoff, Caldwell Hall

Landscape Architecture [M.L.A.], L. J. Mirin, W. Sibley Hall

\*Microbiology, V. J. Stewart, Wing Hall

Natural Resources, M. E. Krasny, Fernow Hall

\*Neurobiology and Behavior, T. Seeley, Seeley Mudd Hall

Nutritional Sciences, G. F. Combs, Jr., Martha Van Rensselaer Hall

\*Physiology, J. F. Wootton, Vet Research Tower

\*Plant Biology, J. J. Doyle, Mann Library Building

Plant Breeding, J. C. Steffens, Bradfield Hall

Plant Pathology, J. W. Lorbeer, Plant Science Building

Plant Protection [M.P.S. (Agr.)], G. C. Bergstrom, Plant Science Building

Pomology, M. P. Pritts, Plant Science Building

Soil, Crop and Atmospheric Sciences, J. H. Cherney, Emerson Hall

Statistics, M. T. Wells, Caldwell Hall

Vegetable Crops, P. M. Ludford, Plant Science Building

\*Zoology, D. M. Noden, Schurman Hall

*\*Division of Biological Sciences*

## Bachelor of Science Degree

Departments in the College of Agriculture and Life Sciences sponsor study for the B.S. degree in sixteen major fields. To qualify for the degree, students must fulfill requirements established by the faculty of the college and administered through the Office of Academic Programs. The following units offer major fields of study for undergraduates. A faculty advising coordinator is listed for each unit. Students should consult with the faculty coordinator regarding requirements and opportunities for concentrations within the major field.

Agricultural and Biological Engineering: K. G. Gebremedhin, 320 Riley-Robb Hall

Agricultural, Resource, and Managerial Economics: R. D. Christy, 203 Warren

Animal Sciences: E. J. Pollak, B-22 Morrison Hall

Atmospheric Sciences: D. S. Wilks, 1113 Bradfield Hall

Biological Sciences, Division of: H. T. Stinson Jr., 200 Stimson Hall; R. M. Sparrow, 216 Stimson

Biometry and Statistics: S. J. Schwager, 339 Warren Hall

Communication: B. O. Earle, 332 Kennedy Hall

Education: D. E. Hedlund, 403 Kennedy Hall

Entomology: S. Via, 4130 Comstock Hall

Floriculture and Ornamental Horticulture: C. F. Gortzig, 23 Plant Science Building

Food Science: J. M. Brown, 101 Stocking Hall

Landscape Architecture: P. J. Trowbridge, 442 Kennedy Hall

Natural Resources: T. J. Fahey, 12 Fernow Hall

Nutrition, Food, and Agriculture: C. A. Bisogni, 334 MVR Hall

Plant Science Units (Plant Biology, Breeding, Pathology/Protection, Pomology, Vegetable Crops): D. R. Viands, 140 Roberts Hall

Rural Sociology: J. D. Francis, 334A Warren Hall

Soil, Crop and Atmospheric Sciences: G. W. Fick, 505 Bradfield Hall

Special Programs in Agriculture and Life Sciences: L. A. Ryan, 140 Roberts Hall

## Summary of Basic College Requirements for Graduation

### 1. Credit Hours

- Minimum: 120
- Minimum with letter grade: 100 (number with S-U grades pro-rated for transfer students)
- Maximum independent study, teaching experience, internships: 15 (pro-rated for transfer students)
- Minimum from College of Agriculture and Life Sciences: 55
- Maximum from endowed colleges without additional charge: 55. Payment must be made for each credit taken in excess of the 55 allowed, whether or not the courses are passed. For the precise fee per credit, students should call the Office of the Bursar.
- Maximum transferred in: 60; minimum at Cornell: 60

Transfer credit will *not* be accepted for the Project Advance Programs. If a student is enrolled in a college/university course, during his/her high school years, transfer credit will be given *only* if certain criteria are met:

- Course must be a standard course taught by a post-secondary institution.
- High school must be a satellite location, one of several options available to *all* students taking the course.
- Course syllabus, text, examinations, and evaluation process must be the same for *all* students at *all* sites.
- Students must be enrolled for college credit and pay college tuition.
- Instructor must be a faculty member (includes adjunct) at the offering college.

If one of these is not met no transfer credit will be given. Written verification may be necessary.

**Note: Credits received for physical education and for certain other courses, such as Mathematics 109, Education 005 and LSC courses, do not count toward the 120 hours but are included on the transcript and in the grade-point average.**

### 2. Residence

- Normally, eight full-time semesters
- Seven semesters, if all other degree requirements are met, with a grade-point average of 2.0
- Minimum of 12 credits per semester
- Minimum of two semesters, including the final semester prior to graduation, in the College of Agriculture and Life Sciences (residency in the Internal Transfer Division [ITD] does not count toward residency in the college)
- Students who have completed 8 semesters in residence at Cornell, including two in the college, and who have 8 or fewer credits remaining for graduation may petition for approval to complete this work elsewhere.

### 3. Physical Education (see note at 1f)

- Completion of university requirement for two terms of work
- Transfer students may be exempt from part or all of the requirement.

Note: Requests for exemption should be made in writing to the University Faculty Committee on Physical Education. Requests for postponement should be referred to Alan Gantert, Teagle Hall (255-4286). Medical postponement requests must go through Gannett Clinic.

### 4. Grade-Point Average (GPA)

- Cumulative GPA: 1.7 or above must be maintained
- Final semester GPA: 1.7 on a minimum of 12 credits in final term before graduation.

Note: Only grades earned at Cornell and while registered in the college are included.

### 5. Distribution

The purpose of the distribution requirement is to provide a broad educational background and acquaint students with a broad range of subject matter. Through study of the physical sciences, students develop quantitative and analytic skills based on an understanding of the physical laws governing the universe; through study of the biological sciences, they gain an appreciation of the variability of living organisms. The social sciences and humanities give students perspective on the structure and values of the society in which we live, and prepare them to make decisions on ethical issues that will impact their work and role in society. Through development of written and oral expression skills, students master the essentials of effective communication.

Credits received for independent study, field, teaching, or work experience, and internships cannot be used to fulfill the distribution requirement. Courses judged to be remedial in the discipline such as Education 005, will not be counted.

Group A: Physical Sciences. 9 credits of 100- or 200- level courses, in at least two disciplines, including at least one course in chemistry or physics.

Chemistry  
Physics

\*Mathematics (excluding Education 005, Mathematics 101 and 109)

Education 115

Soil, Crop and Atmospheric Sciences 131

Biometry

Astronomy

Geology

Statistics

\*The college mathematics requirement is described below.

Group B: Biological Sciences. 9 credits, including 6 of introductory biological science.

Biological Sciences (except 152, 160, 200 unless permission of associate director of the division of Biological Sciences is obtained), 202, 205, 206, 208, 209, 301 or 367)

Animal Sciences 100, 221, 300, 301

Entomology 212

Nutritional Sciences 262

Plant Breeding 201, 225

Plant Pathology 309, 401

Group C: Social Sciences and Humanities. 12 credits (6 in each of the following two categories):

Social Sciences. 100- through 400-level courses in the following departments (*excluding* Freshman Seminars):

Anthropology  
Archaeology

CEH 110/CEH 111 (cannot receive credit for these courses and Econ 101/Econ 102)

Communication 418, 422

Economics (except Agricultural Economics)

Education 271, 311, 317, 370, 378

Government

HDFS 150 (cannot receive credit for this course and Soc 243)

LA/CRP 261, 360, 363

LA/ARKEO 365

Psychology

S & TS 324, 350, 390, 391, 400, 401, 402, 406, 407, 412, 425, 427, 431, 442, 467, 483

Sociology (including Rural Sociology except RS 100, 175, 318, 442)

Humanities. 100- through 400-level courses in the following departments (*excluding* Freshman Seminars and language courses):

Africana Studies (literature and history)

Asian American Studies

Asian and Near Eastern Studies (history and literature)

Classics

Comparative Literature

English (*literature only*)

French, German, Italian, Russian, and Spanish (*literature only*)

History

History of Art/History of Architecture

LA 282

Music and Theatre Arts (theory, literature, and history only)

Natural Resources 411

Philosophy (also Natural Resources 407)

Religious Studies

Rural Sociology 100, 175, 318, 442

S & TS 205, 206, 233, 250, 281, 282, 286, 292, 358, 360, 381, 384, 389, 433, 444, 447, 472, 481, 490

WOMNS/S&TS 444

Group D: Written and Oral Expression. 9 credits, of which at least 6 must be in written expression, selected from the following:

Freshman Seminars

Communication 201, 350, 352, 360, 363, 365

English 280-281, 288-289, 382-385, 388-389

## 6. Mathematics

The faculty requires minimum competency in mathematics as a requisite to satisfactory completion of a degree. As a measure of their competency in mathematics, all entering undergraduates, including those presenting advanced placement or transfer credit in college calculus, must take the college's math proficiency test. The test is administered free of charge just prior to registration each semester. No student may repeat the proficiency test. It consists of fifty sample questions from arithmetic, algebra, geometry, trigonometry, and basic calculus.

The score on the math test has two components and will place each student in one of three groups, defined by the score of each component of the math test.

## Mathematics requirements for each group

**Group I** Students in this group are exempt from the math requirement. If further math is needed for the major area of study, they should consider taking calculus (MATH 111 or MATH 191).

**Group II** Students in this group MUST complete one math course at Cornell usable in Group A. The recommended math course is EDUC 115 or MATH 105. BTRY 101 is also acceptable.

**Group III** Students in this group must take remedial math and are automatically registered in EDUC 005 and must also complete one math course at Cornell usable in Group A.

## Transfer credit for mathematics

Most college-level math courses in a transfer student's record will be transferred (limit 6 hours into Group A of the college distribution), and the student will be held for the results of the math test and must satisfy the college's math requirement.

Students entering with A-P calculus credit will also be held for the results of the math test, and must satisfy the college's math requirement.

## 7. Faculty Adviser

a. Each student is assigned to a faculty adviser soon after being admitted to the college. The faculty adviser will help the student plan a program of study and enroll in courses appropriate to the degree programs offered by the college.

b. Course enrollment each semester should be planned in consultation with the faculty adviser. Students pre-enroll for courses by computer through CoursEnroll on the Bear Access menu. Pre-enrollment by computer is not valid until the student's individual code is entered. This code, or advisor key, is obtained from the faculty adviser after approval of the choice of courses.

c. All academic plans, such as acceleration and graduate study, should be made in consultation with the student's faculty adviser. Support of the adviser is essential if a student petitions for an exception to any of the requirements of the college.

## 8. Progress toward the Degree

a. The progress of each student toward meeting the degree requirements is recorded each term in the college registrar's office on a summary of record form.

b. Students who have been in residence for eight semesters and who have met the graduation requirements will be graduated. Students are entitled to attend for the full eight semesters even if they have completed the graduation requirements in fewer semesters, but must notify the College Registrar of their intent prior to the graduation date. A student who wishes to continue study after graduation must apply for admission as a special student.

c. Application to graduate. Students who are planning to graduate must complete an "Application to Graduate" by February 15th (for May graduate) or September 15th (for January graduate). The adviser signs the application after verifying that the requirements of the major have been completed. The college registrar signs it after verifying that the college requirements have been met.

## STUDENTS

Undergraduate enrollment is approximately 3,000, with about 56 percent in the upper division. Each year about 850 students are graduated, while 650 freshmen and 250 transfer students are enrolled. Members of the faculty of the college serve as chairs of the Special Committees of about 1,000 graduate students.

## Admission

The College Admissions Committee selects applicants who are academically well prepared and appear most likely to profit from the college's various curricula.

Most students come from New York State, but around 30 percent come from other parts of the United States or abroad. About half of the undergraduates are women. Approximately 18 percent are identified as members of minority ethnic groups.

## Transfer Students

Approximately 18 to 20 percent of the ALS undergraduate students are transfers who have taken part of their collegiate work at community colleges, agricultural and technical colleges, or other four-year institutions. Many of them hold an associate degree.

A Cornell student in good standing may apply for intra-university transfer to pursue a course of study unavailable in his or her current college. Guidelines are available in the Admissions Office of the College of Agriculture and Life Sciences, 177 Roberts Hall. The procedure includes filing a transfer request and submitting a letter explaining reasons for making the transfer.

Consideration is given to students who have demonstrated an interest in their intended field of study, by taking appropriate prerequisite courses and courses within this area of study. Academic achievement is also considered. Students are seldom allowed to transfer during their freshman year.

In some cases a student may be referred to the Internal Transfer Division to study for one semester before entering the college. A second semester is considered under unusual circumstances. During this trial semester the student must achieve a predetermined average (usually 2.7) and take approved courses to assure acceptance.

## Special Students

A limited number of non-degree candidates who want to take selected courses in the college are admitted each year. Applicants should submit the standard Cornell application, a resume of their work experience and a list of the courses they want to take. For more information, students should contact the Admissions Office, 177 Roberts Hall.

## Part-time Students

All students in the College of Agriculture and Life Sciences are expected to be enrolled as full-time students in a registered program of study. Part-time students must register in the Division of Summer Session, Extramural Courses, and Related Programs. The Continuing Education Information Service, B-20 Day Hall, provides information, counseling, and special programs for mature students throughout the university.

## Off-Campus Students

Programs in which students study off campus but enroll for Cornell credit include SEA semester, field study in human ecology or industrial and labor relations, Albany programs, Cornell-in-Washington, student teaching, IPM internship, and clinical microbiology internship. Students intending to receive Cornell credit for work done off campus should inform the college registrar at the time of enrolling for courses to ensure that proper registration will occur.

## Off-Campus Courses

Students in CALS are to be registered for at least twelve (12) hours of course work each semester. It is expected that students will not be enrolled in course work at another institution while they are enrolled at CALS.

Two exceptions to enrollment elsewhere while being a full time student at Cornell would be the joint enrollment agreements between Cornell and Ithaca College and Wells college. Other exceptions would be reviewed by the Committee on Academic Achievement and Petitions. Students must petition *before* enrolling for a course elsewhere. The committee would approve such petitions only when there are compelling circumstances such as severe scheduling problems or no equivalent course available at Cornell. Enrolling in a course at another college to avoid taking it at Cornell is discouraged.

## Leave of Absence

A student considering taking a leave of absence from the university should contact the Counseling and Advising office in the Office of Academic Programs. A petition must be filed when requesting a voluntary leave of a semester or more. Students returning from a voluntary leave of absence do not need to reapply for admission; but students on a restricted leave must request permission from the Committee on Academic Achievement and Petitions. Petitions and information are available from the Counseling and Advising office.

## Withdrawal

A student who finds it necessary to leave the university permanently should file a petition for withdrawal. Such petitions are approved if the student is in good standing. Students who have withdrawn and who later decide to return must apply to the Admissions Office.

## Graduation

Graduating seniors must complete the "Application to Graduate." They are distributed to those who have completed the degree requirements and have been approved by the college faculty. After the commencement ceremony at Schoellkopf Field,

graduates return to the Ag Quad to obtain their diplomas.

## ADVISING AND COUNSELING SERVICES

Faculty members in the College of Agriculture and Life Sciences recognize that students need information and advice to make intelligent decisions while they are in college. They believe that personal contact on a one-to-one basis is an important way to identify individual differences and needs of students. Faculty members believe that they can and should be an important source of information and advice on both academic and personal matters. Thus they consider advising to be an important and integral part of the undergraduate program.

The Counseling and Advising office has overall responsibility for coordinating the college advising and academic counseling program. Each student enrolled in the college is assigned to a faculty adviser in the major field of study for aid in developing a program of study, and peer advisers are available to help with problems of a general nature relating to personal matters and campus life.

Counseling and Advising provides a variety of services for undergraduates in the College of Agriculture and Life Sciences. The staff is available to counsel and advise students with academic, social, and personal concerns. In addition, tutoring is offered, at no charge, by the college's honor society, Ho-Nun-De-Kah. Assistance is also available for students submitting petitions for waiver of college regulations and for students considering study abroad.

The Counseling and Advising office is located at 140 Roberts Hall, and appointments are not necessary. Questions regarding services and college procedures should be directed to the Counseling and Advising staff.

Minority students in the College of Agriculture and Life Sciences receive counseling, tutoring, advising, and referral to agencies that will meet their special needs. The Educational Opportunity Program (EOP) is a state-supported program intended to assist New York State students who meet specific economic and academic criteria set by the State Programs Office and the NYS Board of Regents. Eligible students are accepted during the admissions process. For further information, please contact Catherine Thompson in 140 Roberts Hall.

The Office of Career Development offers a variety of helpful services in a friendly environment to all students and alumni of the college. Career development includes self-awareness and assessment, career exploration, decision making, and job search. Services are designed to assist students and alumni with those activities and to help them develop the career planning and job search skills they will find useful as their career paths progress and change.

The Career Library contains an extensive collection of current and useful material, including career information books, extensive internship files, employer directories, and job listings. Alumni Career Link is a database of several hundred college alumni who have offered to help students and alumni with their

career development in a variety of ways. Job search talks on topics such as resume writing, cover letter writing, and interview skills are presented throughout the semester and are available on videotape. An active on-campus recruiting program brings more than 80 employers to campus each year to interview students for full-time and summer jobs.

The office, in conjunction with a network of college faculty members, assists students throughout their undergraduate years and beyond. For further information, students should contact Bill Alberta and the staff in 177 Roberts Hall.

Financial aid is administered through the university office in Day Hall. Endowment funds and annual donations provide supplemental aid for students in the college who are eligible for aid. Information about these college grants is available from the Office of Academic Programs in Roberts Hall, after students have a financial aid package established through the university office in Day Hall. Grants recommended by the college Financial Aid and Scholarship Committee are processed through the university's Office of Financial Aid.

## Academic Integrity Policy

The College of Agriculture and Life Sciences faculty, students, and administration support and abide by the university Code of Academic Integrity. Its principle is that absolute integrity is expected of every student in all academic undertakings: students must in no way misrepresent their work, fraudulently or unfairly advance their academic status, or be a party to another student's failure to maintain academic integrity.

The maintenance of an atmosphere of academic honor and the fulfillment of the provisions of the code are the responsibility of the students and the faculty. Therefore, all students and faculty members shall refrain from any action that would violate the basic principles of this code.

- 1) Students assume responsibility for the content and integrity of the work they submit, such as papers, examinations, or reports.
- 2) Students are guilty of violating the code if they
  - knowingly represent the work of others as their own
  - use or obtain unauthorized assistance in any academic work
  - give fraudulent assistance to another student
  - fabricate data in support of laboratory or field work
  - forge a signature to certify completion or approval
  - knowingly deprive other students of library resources, laboratory equipment, computer programs, and similar aids
  - in any other manner violate the principle of absolute integrity
- 3) Faculty members assume responsibility to make clear to students and teaching assistants specific regulations that apply to scholarly work in a discipline.



- 4) Faculty members fulfill their responsibility to
- maintain in all class, laboratory, and examination activities an atmosphere conducive to academic integrity and honor
  - make clear the conditions under which examinations are to be given
  - make clear the consequences of violating any aspects of the code
  - provide opportunities for students to discuss the content of courses with each other and help each other to master that content and distinguish those activities from course assignments that are meant to test what students can do independently
  - state explicitly the procedures for use of materials taken from published sources and the methods appropriate to a discipline by which students must cite the source of such materials
  - approve in advance, in consultation with other faculty members, which work submitted by a student and used by a faculty member to determine a grade in a course may be submitted by that student in a different course
  - monitor the work and maintain such records as will support the crucial underpinning of all guidelines: the students' submitted work must be their own and no one else's

Cornell's Code of Academic Integrity spells out how individuals who have allegedly violated Cornell standards for academic integrity are to be confronted and, if found to be in violation of those standards, sanctioned. The code provides for informal resolution of most perceived violations through a primary hearing between the faculty member and the student involved. If necessary, a hearing before a hearing board follows.

The Academic Integrity Hearing Board for the College of Agriculture and Life Sciences consists of three elected faculty members, three elected student members, a chair appointed by the dean, and the director of counseling and advising, who serves as a nonvoting record keeper. Professor D. Grossman is the current chair.

Individuals who observe or are aware of an alleged violation of the code should report the incident to the faculty member in charge of a course or to the chair of the hearing board. General information and details on procedures for suspected violations or hearings are available from the Counseling and Advising office, 140 Roberts Hall.

## ACADEMIC POLICIES AND PROCEDURES

### Records

The college registrar maintains for each student a complete record of academic achievement. A permanent record card is on file for each matriculated student and is updated whenever new information becomes available. Staff members are available in Roberts Hall to consult with students regarding the assignment of credit toward

meeting distribution and elective requirements and to verify the official summary of record.

The Committee on Academic Achievement and Petitions is a standing committee of six college faculty members and two students. On behalf of the faculty and subject to its review, the committee

- reviews, at the end of each semester and at other times as shall seem appropriate to the committee, the progress of students
- receives and acts upon petitions from individual students asking for exceptions from particular academic regulations or requirements of the college, or for reconsideration of action previously taken by the committee
- acts upon readmission requests from persons whose previous enrollment was terminated by the committee
- notifies the petitioner in writing of the action taken by the committee

Good academic standing means a student is eligible for, or has been allowed to register and enroll in, academic course work for the current semester. Whether an individual student is in good academic standing is determined by the college registrar and the Committee on Academic Achievement and Petitions.

A petition to be exempt from a college academic requirement or regulation may be filed by any student who has grounds for exemption. Forms are available in the Counseling and Advising office, 140 Roberts Hall.

A petition is usually prepared with the assistance of a student's faculty adviser, whose signature is required; it indicates the adviser's awareness of the petition. The adviser's recommendation is helpful to the committee. The committee determines whether there is evidence of mitigating and unforeseen circumstances beyond the control of the student that would warrant an exemption or other action.

### Registration Procedures

All students must register with the university and "check-in" with this college at the beginning of each semester. Registration materials are available in 140 Roberts Hall at a time and place announced each term by the Office of the College Registrar.

### Course Enrollment Procedures

To enroll in courses, students will receive information from the university registrar; plan a schedule in consultation with their adviser; and pre-enroll by computer, through CoursEnroll in "Just the Facts" on the Bear Access menu. Pre-enrollment is not valid until entering the student's individual code, or adviser key, into the computer. Adviser keys change each semester and are obtained from the adviser.

To enroll in courses that involve independent study, teaching, or research, a student must file an independent study form, available in the college Registrar's Office, 140 Roberts Hall. Students who will be studying off campus or abroad should file the Intent to Study Off Campus form to ensure that proper registration will occur. These forms are available in the Program Office (Cornell Abroad, 474 Uris Hall).

Students may enroll again for a course in which they received a grade of F in a previous semester. Both grades will be recorded and calculated as part of their GPA.

Students must *not* enroll again for a course in which they received an incomplete or NGR. Instead, work for that course should be completed, and the instructor files an incomplete make-up form or manual grade form to assign the grade. An incomplete not made up by the end of two successive semesters of registration reverts to a failure. In the case of a graduating senior, incompletes revert to failures at the time of graduation.

Students enrolled in a two-semester course will receive an R at the end of the first semester and should enroll again for the same course the second semester. The letter grade will be recorded for the second semester when all work for the course is completed. A note on the transcript will explain the two grades for the same course.

A student is held responsible for and receives a grade for those courses in which he or she enrolls unless the student officially changes such enrollment. All changes in courses or credit, grading options, or sections must be made by the student at the Registrar's Office, 140 Roberts Hall, on an official form provided for that purpose.

Add/Drop/Changes are made by filing properly signed forms in the Registrar's Office, 140 Roberts Hall. Approval and signature of the faculty adviser and course instructor are required to add or to drop a course.

Students may add courses and change grading options or credit hours where applicable during the first three weeks of the term and may drop courses until the end of the seventh week.

Students wishing to withdraw from a course after the end of the seventh week must petition to the college Committee on Academic Achievement and Petitions. A form is available in Counseling and Advising, 140 Roberts Hall. Requests for course changes are approved only when the members of the committee are convinced that unusual circumstances are clearly beyond the control of the student. The committee assumes that students should have been able to make decisions about course content, total work load, and scheduling prior to the end of the seventh week of the semester.

If the petition to drop a course is approved after the end of the seventh week of classes, the course remains on the student's record and a W (for "withdrawal") is recorded on the transcript.

### Grade Reports

Grade reports for the fall term are included in spring term check-in materials; grade reports for the spring term are mailed by the Office of the University Registrar to students at their home addresses unless alternative addresses are reported to the college or university registrar by mid-May.

### Academic Deficiency Policies

At the end of each semester, the Committee on Academic Achievement and Petitions reviews the records of those students who in any respect are failing to meet the academic requirements of the college or who persis-

tently fail to attend classes. In case of students not making satisfactory progress, the committee takes appropriate action, including, but not limited to, issuing warnings to students, placing them on probation, suspending them, decreeing that they may not reregister, granting them leaves of absence, and advising them to withdraw.

Specifically, the committee considers as possible cause for action failure to attend and participate in courses on a regular basis or, at the end of any semester, failure to attain one or more of the following:

- semester GPA of at least 1.7
- cumulative GPA of at least 1.7
- satisfactory completion of 12 or more credits per semester
- reasonable progress toward completion of distribution requirements
- appropriate completion of college and university requirements

In general terms, regular participation in course work with academic loads at a level sufficient to assure graduation within eight semesters and grades averaging C- (1.7) or higher are prima facie evidence of satisfactory progress.

## HONORS PROGRAM

The Bachelor of Science degree with honors will be conferred upon those students who, in addition to having completed the requirements for the degree of Bachelor of Science, have satisfactorily completed the honors program in their area of major interest and have been recommended for the degree by the honors committee of that area.

An undergraduate wishing to enroll in the honors program must have completed at least 55 credits, at least 30 of the 55 at Cornell. Also, the student must have attained a cumulative grade-point average of at least 3.0 at the time of entry.

Interested students must make written application no later than the end of the third week of the first semester of their senior year, but are encouraged to make arrangements with a faculty member during the second semester of their junior year. An application form is available from the college registrar, 140 Roberts Hall, or from the area committee chair. (Biological sciences students should get applications at 200 Stimson Hall.)

Written approval of the faculty member who will direct the research and of the honors committee in the area is required. After the college registrar verifies the student's grade-point average, the student will be officially enrolled in the honors program.

Academic credit may also be earned by enrolling in an appropriate independent study course. When applying for admission to the program, the student may, if appropriate, submit a budget and a modest request for funds to cover some of the costs the student incurs in doing the research.

The honors committee for each area recommends to the college registrar those students who qualify for honors. Only those who maintain a GPA of at least 3.0 will be graduated with honors.

Students in the College of Agriculture and Life Sciences wishing to participate in the honors program must be accepted in one of the program areas approved by the faculty. Students are not eligible for honors by participating in a program offered by another college or administrative unit.

## Animal Sciences

Faculty committee: W. B. Currie, chair; Y. R. Boisclair, P. A. Johnson, E. A. Matitashvili

The objective of the animal sciences honors program is to provide outstanding undergraduates with the opportunity to pursue supervised independent research and to develop an awareness of the scientific process. It is expected that the research will require significant effort and creative input by the student in its design and execution and in the reporting of the results.

Those students with majors in animal sciences who are interested in doing an honors project should consult with their faculty advisers early in their junior year. All students are expected to meet the college requirements in qualifying for the program and to complete the following:

- Identify a potential honors project sponsor (i.e., a faculty member working in the animal sciences) and secure that faculty member's commitment to sponsor the student in the honors project. That should be accomplished early in the second semester of the junior year.
- Preregister during the spring semester for AS 496, Animal Sciences Honors Seminar, which is offered in the fall semester.
- Register for AS 499, Undergraduate Research.
- Participate in AS 402, Seminar in Animal Sciences, during the spring semester and report on and discuss the project and results.
- Submit a written thesis to the honors committee by the scheduled deadline. Specific information regarding deadlines, format, and organization for the thesis will be provided.
- Meet with the honors committee for a short oral defense of the thesis following a review of the thesis by the student's sponsor and the honors committee.

Details pertaining to the specific requirements of the program can be obtained from the office of the committee chair, 434 Morrison Hall.

## Biological Sciences

Students interested in the honors program in the biological sciences should consult with their faculty advisers and with potential faculty research sponsors early in their junior year. See "Independent Research and Honors Program" in the Biological Sciences section of this catalog for complete details. Applications and details pertaining to the program requirements may be obtained from the division's Office for Academic Affairs, 200 Stimson Hall. Information on faculty research activities is available in the Behrman Biology Center, 216 Stimson Hall.

## Entomology

Faculty committee: B. L. Peckarsky, chair

An honors program in the area of entomology may be pursued by any qualified student in the College of Agriculture and Life Sciences (see the requirements at the beginning of this section). The student need not be specializing in entomology. Insects, because of their variety, small size, and easy availability, are convenient subjects for study in a wide array of problems dealing with living systems. Short life cycles, unique physiologies and developmental patterns, and species with easily managed colony requirements and a wide range of behavioral traits provide the raw material for honors study. Cornell's diverse faculty interests and extensive collections and library in entomology are also major assets if a student selects entomology as the area for honors study.

The honors committee requires that an undergraduate who is interested in embarking upon an honors project proceed with the following steps:

- Discuss the matter with his or her academic adviser, preferably in the junior year, so that a research project can be carefully planned. The possibility of conducting some research during the junior year and/or summer should be discussed.
- Discuss the project with an appropriate faculty member in the Department of Entomology who can serve as a supervisor to oversee the honors research. (The faculty adviser will be of assistance in determining which faculty entomologist might be the best supervisor, the decision being based primarily on available faculty members' areas of expertise.)
- Prepare a brief, tentative plan for the project for discussion and approval of the honors project supervisor. The plan should include a statement of objects or hypotheses, proposed methods for testing hypotheses, needs for laboratory space or shared equipment, and a budget outlining financial support needed for travel and supplies.
- Present a completed application to the chair of the entomology honors committee no later than the end of the third week of the first semester of the senior year. Earlier submission is encouraged.
- Submit a brief progress report, approved by the project supervisor, to the entomology honors committee by midterm of the semester in which the student will complete his or her graduation requirements.
- Present a formal seminar reporting the significant findings of the research to the Department of Entomology (preferably as a Jugatae seminar) in the last semester of the senior year.
- Submit two copies of the final project report (honors thesis) to the chair of the entomology area honors committee no later than two weeks before the last day of classes in the semester in which the student anticipates graduation. The thesis will be reviewed by the faculty honors project supervisor and one other referee from the department honors committee. The committee will return the thesis to

the student one week before the last day of classes. If reviewers indicate that changes must be made, the revised thesis should be submitted to the chair no later than the last day of classes.

## Natural Resources

Faculty committee: M. E. Krasny, chair; B. A. Knuth, J. P. Lassoie, E. L. Mills

The honors program in natural resources provides an opportunity for undergraduates to pursue supervised independent research in the areas of (1) ecology and management of landscapes; (2) fish and wildlife biology and management; and (3) resource policy, management, and human dimensions. The subject matter and nature of the research experience may be quite varied in this program but require the guidance and supervision of a faculty member with substantial interest and expertise in the subject area chosen.

In addition to meeting requirements of the college, the student is expected to do the following:

- Register for the honors program in the junior year or earlier.
- Select a faculty adviser who will help identify and formulate a research problem.
- Carry out an independent research effort that is original and separate from the work of others who may be investigating similar subjects.
- Describe and summarize the work in the format of a conventional master's thesis or in the form of a scientific paper ready for journal submission. About half of the theses have been published.
- Work closely with at least two faculty or staff members who will agree to serve as readers for the thesis. Provide readers with a copy of the guidelines for evaluation of honors theses, available from the department's honors program committee.
- Take the lead role for meeting each of the above expectations.

## Nutritional Sciences

Faculty committee: M. N. Kazarinoff, R. S. Parker

The honors program offers students a research experience structured to give them the opportunity to choose a research project, search the literature relevant to it, plan and execute the research, and write it up in the form of a thesis. As in other types of research available to undergraduates, each student is guided by a faculty mentor. The honors project is designed to be spread over both semesters of the junior and senior years.

Students who consider this option should be aware that it involves a number of deadlines and considerable time commitment. Before signing on for honors they need to consult with their academic advisers to make sure that honors will not interfere with other academic objectives, such as preparation for admission to medical school or making the dean's list. Although honors research credits for spring semester junior year and both semesters senior year are designed LET, individual mentors may choose the R grade for work in progress until the project has been fully

completed. An outline of activities for both years is given below. Letters of invitation are sent to upcoming juniors during the summer.

### Junior Year

**Fall Semester** Course No: NS 398 (1 credit, S-U): Students are oriented to the program, and provided material that summarizes the range of research activities in DNS. Students begin making arrangements with faculty members. When these arrangements have been completed, students will begin a literature search that focuses on their research problems.

**Spring Semester** Students register for NS 498 (1 credit, section 1). Additional faculty presentations of research opportunities are made and orientation to supportive services available through DNS are made. Placements with faculty mentors should be completed by spring break. Each student may also register under the number NS 499 for a convenient number of credits, to be determined in consultation with the chosen adviser. Work carried out will have two objectives:

1. to become familiar with literature and/or research methods appropriate to the problem for the honors research,
2. to develop a research proposal.

The semester outcome will be written reports/discussions of the method(s) or literature searches and a short research proposal, evaluated by the research adviser.

### Senior Year

**Fall Semester** Students will register under the number NS 499 (2-4 credits, LET, by arrangement with their mentors). They may begin their research earlier than fall, e.g., during the summer, or even earlier, but should be prepared to begin research **early in the fall semester at the latest**. The objective for the semester will be to conclude most of the hands-on research/data acquisition.

**Spring Semester** Students will again register under course number NS 499 for 2-4 credits LET, by arrangement with their research mentors. Much of the allotted time will be spent on data analysis and on writing the honors thesis.

Several important deadlines should be noted.

1. **Last week in March:** The names of thesis readers\*\* are to be in the hands of the honors committee.
2. **Third to fourth week of April:** A final draft of the thesis is handed to the readers.
3. **First to second week of May:** Scheduled seminars for oral presentations of each student's research.
4. **Last day of classes:** Final form of the thesis is handed to the honors chairman.

To help students meet these deadlines, students register for NS 498 (1 credit, section 2) class sessions will be held before spring break for guidance in thesis writing and/or informal reporting of preliminary data. After spring break the group will meet once or twice (depending on number of students) to practice oral presentations of completed research.

\* Grade is determined by each student's mentor.

\*\*Two readers knowledgeable in the area of the student's research topic to be chosen by the honors committee and faculty advisers.

## Physical Sciences

Faculty committee: C. E. McCulloch, chair; G. W. Fick, J.-Y. Parlange, S. S. H. Rizvi

The honors program in physical sciences provides outstanding students with an opportunity to do independent research under the supervision of a faculty member in the Departments of Agricultural and Biological Engineering; Soil, Crop, and Atmospheric Sciences; Food Science; or in the Biometrics Unit.

Students must be enrolled in the program for a minimum of two semesters and must also enroll in the appropriate departmental independent study course for a total of at least 6 credits. They must submit a report of their research, usually in the form of a journal article, to the honors committee by the end of classes of the semester in which they expect to graduate.

Details of the program can be obtained from the chair of the physical sciences honors committee.

## Plant Sciences

Faculty committee: R. L. Obendorf, chair; L. L. Creasy, A. M. Petrovic, W. A. Sinclair

Students perform independent scientific research under the guidance of faculty members in fields of horticultural, agronomic, and soil sciences; plant biology; plant breeding; and plant pathology. For admission to the program, students must meet college requirements and submit to the Plant Sciences Honors Committee a project proposal (2-3 pages) which includes a title; a brief background to the problem (justification and literature review); a clear statement of objective(s) and hypotheses to be tested; methodology and experimental plan, necessary space, equipment and supplies; and a project budget. The proposal must be accompanied by a letter from the faculty supervisor stating that he or she has approved the project plan and that its completion within the remainder of the student's undergraduate tenure is feasible.

Successful completion of the honors program requires acceptance by the honors committee of two copies of a research report. The report should be written in the format of a research publication in the appropriate scientific field. The acceptable report must have been reviewed and corrected according to recommendations of the research supervisor before the report is submitted to the honors committee. The report must be received by the honors committee at least two weeks before the last day of classes of the semester in which the degree is sought and must be accompanied by a letter from the research supervisor evaluating the research and, if appropriate, recommending graduation with honors.

The honors committee will review the report within one week and may accept it or return it to the student with specific recommendations for revisions. A suitably revised version must be submitted to the committee before the second day of the examination period. When the committee accepts an honors report, the chair will recommend to the Director of Academic Programs and to the College

Registrar that the student be graduated with honors. One copy of the accepted report will be returned to the student with review comments from the committee. The other copy will be shelved in Mann Library.

### Social Sciences

Faculty committee: B. V. Lewenstein, chair; K. A. Strike, M. J. Pfeffer, W. H. Lesser

Acceptance into the social sciences honors program of the College of Agriculture and Life Sciences is contingent on meeting all the criteria described above, on information in the student's written application, and on a detailed thesis proposal. The application and proposal are due no later than the third week of the first semester of the senior year. Each student is encouraged to begin working on this proposal with a prospective faculty thesis adviser during the first semester of the junior year. The purpose of the proposal is twofold. First, it formalizes a plan of study and establishes a set of expectations between the student and his or her faculty adviser. Second, the Honors Committee reviews the proposal to determine whether it is consistent with honors thesis requirements, and to make suggestions for improvement.

The proposal must be 5-10 typed, double-spaced pages in length and include the following sections:

- **Research Topic:** This section should contain a statement of the problem to be studied or the topic of interest. The relevant literature should be briefly reviewed and the background of the problem or topic discussed; a more extensive bibliography should be included.
- **Research Questions/Empirical Hypotheses:** This section should contain specific questions to be answered or hypotheses to be empirically tested via collection of data and some mode of analysis accepted in the social sciences.
- **Research Methods:** This section should contain a discussion of models to be constructed, data collection procedures (including survey instruments or experiments, if appropriate), and methods of analysis.
- **Expected Significance:** What new knowledge or information is likely to be forthcoming and why is it important?

Faculty advisers must be members of the graduate faculty. Exceptions to this rule will be granted for persons with special expertise who are deemed capable of thesis supervision; exceptions will be granted pending petition to the social science honors committee. Students may register for independent study directed by the faculty adviser in conjunction with an honors project.

Honors degrees are awarded upon approval of the honors thesis by the social science honors committee. The research should deal with a substantive issue within one of the fields in the social sciences. Both the results of the research and the methodology (or the argument by which the results were achieved) must be reported. Reviews of the literature, practical conclusions or applications, or broad characterizations of an area of inquiry may constitute part of the research report but are not themselves sufficient to count as research.

Honors theses should be written according to the form of any standard journal within the appropriate fields. Four copies of the thesis must be submitted to the chair of the social science committee no later than three weeks before the last day of classes of the semester for which the degree is sought. A supporting letter from the faculty member supervising the work also must be submitted. Approval of the thesis requires a majority vote of the honors committee.

### INTERCOLLEGE PROGRAMS

The College of Agriculture and Life Sciences does not participate in any dual-degree programs. Study for the Bachelor of Science is the only undergraduate degree program offered.

**The College of Veterinary Medicine** may accept students who are then permitted to double-register in their seventh or eighth semester and complete requirements for the Bachelor of Science degree in the College of Agriculture and Life Sciences. Students should consult with the college registrar, 140 Roberts Hall, to ensure that degree requirements have been fulfilled.

**Students who have been offered admission to the S. C. Johnson Graduate School of Management** upon completion of the B.S. degree in Agriculture and Life Sciences may take a program of management courses in their senior year if it is approved by their college faculty adviser as part of their undergraduate program. In certain cases an "upset" tuition charge, equal to the endowed undergraduate tuition rate, will be applied for undergraduate statutory college students taking excess credit hours from endowed colleges and schools. Inquiries should be directed to the university bursar.

**Students in the Field Program in Agricultural and Biological Engineering** are usually enrolled in the College of Agriculture and Life Sciences during the freshman and sophomore years and jointly enrolled in this college and the College of Engineering in the junior and senior years. Students pay the engineering college tuition in the junior year. The curriculum is accredited by the Accreditation Board for Engineering and Technology. The B.S. degree is awarded in cooperation with the College of Engineering.

**The Program in Landscape Architecture** is cosponsored by the Department of Floriculture and Ornamental Horticulture in the College of Agriculture and Life Sciences and by the College of Architecture, Art, and Planning. The program offers a first professional degree curriculum in landscape architecture at both undergraduate and graduate levels, as well as a graduate second professional degree program.

**The Division of Nutritional Sciences** is an intercollege unit affiliated with the College of Human Ecology and the College of Agriculture and Life Sciences. The undergraduate nutrition major is based in the College of Human Ecology. Students in Agriculture and Life Sciences may study nutrition in areas such as animal sciences; food-industry management; food science; microbiology; nutrition, food, and agriculture; and fruit or vegetable science. Students may also plan a concentration in biological sciences or a concentration

in general studies in agriculture to include a human nutrition component.

**The Department of Science and Technology Studies** is an academic unit that engages in teaching and research involving the interactions of science and technology with social and political institutions. The program draws its students, faculty, and research staff from the various divisions of the university, including the College of Agriculture and Life Sciences. It offers an interdisciplinary undergraduate major in Biology and Society. A concentration in general studies in the agriculture major may be planned in consultation with a faculty adviser to include a biology and society component. Further information, including a list of courses, may be obtained from the undergraduate office, 275 Clark Hall.

**The American Indian Program (AIP)** is a multidisciplinary intercollege program with instructional, research, and extension components. The instructional core consists of courses focusing on American Indian life with emphasis on the Iroquois and other Indians of the Northeast. A description of the program and general information is available from the director of the American Indian Program, Caldwell Hall.

**The Comparative and Environmental Toxicology Program** is an interdisciplinary intercollege program with research, teaching, and cooperative extension components coordinated by the Institute for Comparative and Environmental Toxicology (ICET). Courses are cosponsored by academic departments in several colleges of the university. A description of the program and general information is available from the director of the program through the ICET office, 16 Fernow Hall.

**The Cornell Laboratory of Environmental Applications of Remote Sensing (CLEARS)** is an interdisciplinary intercollege center with teaching, research, and extension components affiliated with the College of Agriculture and Life Sciences and the School of Civil and Environmental Engineering. A description of the program and general information is available from the director through the CLEARS office in Hollister Hall.

### OFF-CAMPUS STUDY PROGRAMS

Study off campus is of two types: (1) credit may be earned at another institution and transferred to Cornell, or (2) credit may be earned in Cornell courses that require off-campus activity.

An Intent to Study Off Campus form should be filed with the college registrar before leaving campus. Tuition may be reduced. In some cases stipends or cost of living allowances are provided. Students should consult with the Office of Financial Aid if receiving financial aid and clear all accounts with the bursar prior to departure.

Students who plan to enroll in courses at another institution in the United States must petition for a leave of absence. Courses should be selected in consultation with the faculty adviser.



## Albany Programs

Study off campus in Albany, the New York State capital, provides a unique opportunity to combine career interests with academic and legislative concerns. Students receive an intensive orientation to state government and attend a lecture-seminar program composed of three two-credit components and offered by professors-in-residence. An internship experience, supervised by an internship committee, provides up to six academic credits. Independent study and research courses offered by the various departments in ALS and/or courses offered by academic institutions in the Albany areas may be elected.

Three opportunities are available. The Assembly Intern Program provides a placement with a member of staff of the New York State Assembly. The Senate Assistants Program has placements with New York State senators and selected staff. The Albany Semester Program provides experience with a state agency such as the Departments of Environmental Conservation, Education, or Labor.

Applicants are screened by the ALS Internship Committee in the term prior to assignments. Those accepted should plan a program of study in consultation with their faculty adviser. At least twelve credits must be carried to meet the residence requirement. Seniors should note that the last term average must be 1.7 or above.

All interns will audit the orientation sessions and meet participation requirements in at least two of the lecture-seminar sections. The paper required in each section constitutes an independent study project to be directed and evaluated by a Cornell faculty member in an appropriate discipline. Normally a faculty member will not sponsor more than one of the independent study courses for any one student. To receive academic credit for the internship, students enroll in ALS 400, for an S-U grade only.

Information and applications are available in the Career Development Office, 177 Roberts Hall.

## Cornell-In-Washington

The Cornell-in-Washington Program offers students from all colleges within the university an opportunity to earn full academic credit for a semester in Washington, D.C. Students take courses from Cornell faculty, conduct individual research projects, and work as externs. The Cornell-in-Washington Program offers two study options: 1) studies in public policy; and, 2) studies in the American experience. Students take part in a public policy or humanities seminar which requires them to serve as externs in federal agencies, congressional offices, or nongovernmental organizations and to carry out individual research projects under the supervision of Cornell faculty. The required externships and all course enrollments are arranged through, and approved by, the Cornell-in-Washington program. Students in the College of Agriculture and Life Sciences must register for ALS 500 and cannot receive credit for the externship experience alone. For further information, see p. 19 or inquire at 471 Hollister Hall, 255-4090.

## SEA Semester

The Sea Education Association is a nonprofit educational institution offering ocean-focused academic programs and the opportunity to live, work, and study at sea. Science, the humanities, and practical seamanship are integrated in small, personal classes. The 17-credit program is twelve weeks in length. Six weeks are spent in Woods Hole, the following six weeks are spent on either one of SEA's two sailing vessels: the R/V Westward, or the R/V Corwith Cramer. For more information, students should contact the Cornell Marine Programs office, G14 Stimson Hall. ALS students should file the intent to study off campus form with the college registrar as early as possible to ensure proper registration and enrollment in courses.

## Shoals Marine Laboratory

The Shoals Marine Laboratory, run cooperatively by Cornell University and the University of New Hampshire, is a seasonal field station located on 95-acre Appledore Island off the coast of Portsmouth, New Hampshire, in the Gulf of Maine. SML offers undergraduate, beginning graduate students, and other interested adults a unique opportunity to study marine science in a setting noted for its biota, geology, and history. Please refer to "Courses in Marine Science," under the section on the Division of Biological Sciences, for a list of courses offered.

For more information, contact the Shoals Marine Laboratory office, G14 Stimson Hall, 607-255-3717.

## Internships

Several departments in the college offer supervised internships for academic credit. Arrangements should be made with the offering department for assignment of a faculty member who will be responsible for placement, for planning the program of work, and for evaluating student performance.

For internships not governed by an established internship course, the student must enroll in a 497 course for the number of credits to be assigned. If the work is done during the summer, the student must enroll in the Cornell summer session for the agreed-upon credits.

In cases where the work is not done at Cornell, the awarding of credits depends upon a prior contractual arrangement between a Cornell professor and the student. Specific terms for receiving credit and a grade should be recorded, using the Independent Study, Research, Teaching, or Internship form, available in the Registrar's Office, 140 Roberts Hall.

A maximum of 15 (pro-rated for transfer students) of the 120 credits required for the degree may be taken in internships, independent study courses, and undergraduate teaching or research. No more than 6 of the 15 credits allowed for independent study may be awarded for internships consisting of off-campus work experiences that do not have the continued presence of a Cornell faculty member. The 6-credit allotment includes transfer credit and credit for internships in other colleges at Cornell. The 6-credit limit does not apply to secondary, postsecondary, and cooperative extension teaching internships in the Department of Education.

The College of Agriculture and Life Sciences does not offer a field study option. In general, a rather narrow view is taken toward awarding academic credit for work experience, "life" experience, or apprenticeships. Credit will only be assigned or accepted in cases where a professor is directly involved in determining both the course content and in evaluating a student's work. The awarding of credit will not be allowed in cases where a student brings to the college or to a professor a description of a past experience and requests credit nor in cases where the student has received financial remuneration.

All students enrolling for an internship must file an Independent Study, Research, Teaching, or Internship form with the Office of the College Registrar. If the study is to take place off campus, the Intent to Study Off Campus form should also be filed with the college registrar.

## Overseas Academic Programs

All students planning to study abroad apply through Cornell Abroad; please see the Cornell Abroad program description in the introductory section of Courses of Study.

The Cornell Abroad program is open to students in all colleges of the university. Students in the College of Agriculture and Life Sciences should consult with their faculty adviser and the college registrar to ensure that credit received for academic work abroad will meet requirements for graduation. The Counseling and Advising office, 140 Roberts Hall, has information and application forms.

The Swedish exchange program is operated in cooperation with the Agricultural College of Sweden at Uppsala. The ALS student selected to participate in the Swedish exchange spends the junior year at Uppsala. All essential expenses in Sweden, including a living allowance, are provided by a student group there. Round-trip air transportation must be paid by the student. An exchange student from Uppsala spends a year at Cornell, supported by the college and the Cornell student in Sweden. A similar program is operated in cooperation with ITESM in Monterrey, Mexico.

## INTERDISCIPLINARY PROGRAMS

### American Indian Studies

Jane Mt. Pleasant, director. Core faculty: B. Lambert, D. L. Moore, K. Shanley, D. Usner, R. W. Venables. Associated faculty: D. J. Barr, S. Baugher, C. C. Geisler, D. J. Greenwood, K. Walkingstick

The American Indian Program (AIP) is a multidisciplinary intercollege program consisting of academic, research, extension, and student support components. Course work is intended to enhance students' understanding of the unique heritage of North American Indians and their relationship to other peoples in the United States and Canada. Students are challenged by such topics as the sovereign rights of Indian Nations and the contemporary relevance of Indian attitudes toward the environment. The program's instructional core consists of courses focusing on American Indian life from pre-contact times to the present, and from the

perspectives of Native people as much as possible. Core courses are supplemented by a variety of offerings in several different departments.

Research areas among faculty active in the program include Indian education, social and economic development, agriculture, environmental issues, history, literature and the arts, and cultural preservation. Their research topics, which are highly relevant to Indian communities, will be of interest to Indian and non-Indian graduate students. Extension and outreach efforts within the program seek to develop solutions to problems identified by Indian communities and to facilitate the application of institutional resources, research, and expertise to community needs.

The American Indian Program publishes its own multidisciplinary journal, *Native Americas*, and sponsors conferences, guest lectures, and forums on important local, national, and international issues. Akwe:kon, the American Indian Residence House, offers undergraduate students a living environment that promotes intercultural exchange.

The American Indian Program offers a concentration in American Indian Studies to undergraduate students in conjunction with their major defined elsewhere in the university. The concentration will be earned upon completion of five courses: Rural Sociology 100 (Introduction to American Indian Studies) and Rural Sociology 175 (Issues in Contemporary American Indian Societies), plus three other courses selected from the following course listing (ANTHR 230, ANTHR 665 ENGL 260, ENGL 269, ENGL 278, ENGL 659, ENGL 669, ENGL 687, HIST 209 HIST 276, HIST 277, HIST 370, HIST 429, HIST 624, R SOC 100, R SOC 175, R SOC 318, R SOC 440, R SOC 442), for a total of at least 15 credits. Students choosing a concentration in American Indian Studies should obtain application materials from the AIP office in 300 Caldwell or consult with K. Shanley, associate director of academic development, American Indian Program, 300 Caldwell Hall, 255-8402.

## Science of Earth Systems

A new program in the Science of Earth Systems (SES) is now available for students in the Colleges of Agriculture and Life Sciences, Arts and Sciences, and Engineering. The SES program emphasizes the rigorous, objective study of the Earth system as one of the outstanding intellectual challenges in modern science and as the necessary foundation for the future management of our home planet. The program, described in more detail in the introductory section of the catalog under, "Interdisciplinary Centers, Programs, and Studies," coalesces Cornell's teaching and research strengths across a broad range of earth and environmental sciences to provide students with a rigorous scientific foundation for the study of our complex, highly interactive earth. The program is being proposed as an inter-college major. At present, students may complete the program as general studies majors or within another compatible field.

The curriculum includes a freshman/sophomore emphasis on strong preparation in mathematics, physics, chemistry, and biology. In the junior and senior years, students take a set of common SES core courses and an additional set of advanced disciplinary or interdisciplinary courses that build on the basic sequences. Students wishing to explore

the new field are encouraged to enroll in the SES Colloquium (register for ABEN 120/121, GEOL 123/124, SCAS 101/102) and one or both of the upper-level core courses offered during the 1996/1997 academic year. These courses are Climate Dynamics (register for SCAS 331, ASTRO 331) and Evolution of the Earth System (register for GEOL 302 or SCAS 332), and Mechanics in the Earth and Environmental Sciences (register for ABEN 385).

A broad range of interdisciplinary tracks is available through course offerings throughout the three colleges. This tracking is accomplished through the selection of courses beyond the core sequence. These courses should build on the core sequence and generally include junior and senior level courses with prerequisites in the basic sciences and mathematics. Effective tracks can be designed to prepare students for careers or graduate study in specific environmental science disciplines including atmospheric sciences, hydrology, biogeochemistry, ecology, oceanography, and geophysics. Meaningful and effective combinations of these disciplines are also possible. The selection of the course sequences must be approved by the SES Coordinating Committee to ensure that depth as well as breadth is attained.

The SES curriculum is described in more detail in the Interdisciplinary Programs section. For more information, contact K. H. Cook in SCAS (255-5123), J. Parlange in ABEN (255-2476), or R. Howarth in BioSci (255-6175).

## MAJOR FIELDS OF STUDY

The college curriculum emphasizes the biological and physical sciences and the technology basic to the study of agriculture and life sciences. The sixteen major program areas reflect the departmental academic effort in the college. Faculty curriculum committees in each area identify a sequence of courses appropriate to all students studying in that field. Courses of study are designed to provide systematic development of basic skills and concepts. Opportunity for concentration in an area of particular interest is usually available.

Programs are planned with considerable flexibility, allowing students to prepare for careers, graduate work, professional opportunities, and the responsibilities of educated citizens. Course requirements in each program area are different, but all students must meet minimum distribution requirements of the college.

## Agricultural and Biological Engineering

Agricultural and biological engineering is at the focus of three great challenges facing humanity today: ensuring an adequate and safe food supply in an era of expanding world population; protecting and remediating the world's natural resources, including water, soil, air, and energy; and developing engineering systems that monitor, replace, or intervene in the biology of living organisms. The undergraduate Engineering Program in the Department of Agricultural and Biological Engineering has a unique focus on biological systems, including the environment, that is realized through a combination of fundamental engineering sciences, biology, applications

courses, and liberal studies. The program leads to a joint Bachelor of Science degree from the Colleges of Engineering and Agriculture and Life Sciences, and is accredited by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET).

Three concentrations in agricultural and biological engineering are offered: environmental systems engineering, biological engineering, and agricultural engineering. All of these students take courses in mathematics, computing, physics, chemistry, basic and advanced biology, fundamental engineering sciences (mechanics, thermodynamics, fluid mechanics, materials, and transport processes), engineering applications, and design. Students select application courses in the department in areas that include bioprocessing, soil and water management, bioenvironmental and facilities engineering, bioinstrumentation, engineering aspects of animal physiology, environmental systems analysis, and waste treatment and disposal. Students select other courses in the College of Engineering that reflect their concentration, such as environmental engineering or biomedical engineering. Students planning for medical school also take organic chemistry. Throughout the curriculum, emphasis is placed on communications and teamwork skills. **Specific course requirements and other information for the Agricultural and Biological Engineering (joint program) are in the section of the College of Engineering in this same publication.**

The department also offers two technology programs: environmental systems technology and agricultural systems technology. The two technology programs emphasize applied and technical aspects of agricultural, biological, and environmental sciences. These programs incorporate courses in basic biological and physical sciences and mathematics as well as engineering and technology, agriculture, business, social sciences, and liberal studies. The student develops his or her own program of advanced and elective courses in consultation with a faculty adviser, and may have an informal minor in an area such as communication, business, education, or international agriculture.

Many undergraduate students participate in teaching assistantships, research assistantships, design teams, Engineering Coop, and study abroad. Students should have a strong aptitude for the sciences and mathematics and an interest in the complex social issues that surround technology.

Career opportunities cover the spectrum of private industry, public agencies, educational institutions, and graduate programs in engineering, science, medicine, law, and other fields. In recent years graduates have developed careers in environmental consulting, biotechnology, the pharmaceutical industry, biomedical engineering, management consulting, and international agriculture.

The living world is all around us, and within us. The biological revolution of this century has given rise to a growing demand for engineers who have studied biology and the environment, who have strong math and science skills, who can communicate effectively, and who appreciate the challenges facing society. Agricultural and biological engineering is training the next generation of engineers to meet these challenges. The

department is located in Riley-Robb Hall and operates specialized facilities that are among the largest and most complete of their kind in the world.

Specific course distribution requirements for the academic programs in environmental systems technology and agricultural systems technology include (for the joint program, see the College of Engineering section):

A. Basic Subjects	Credits
1. Calculus	8
2. Chemistry	6
3. Physics	8
4. Introductory biological science	6
5. Computer applications	4
6. Statistics or probability	3
7. Economics	3
8. Oral communication	3
B. Advanced and Applied Subjects	
1. Five courses in the agricultural, biological, or environmental sciences	15
2. Five engineering courses at the 300 level or above; at least 9 credits in agricultural and biological engineering	15
C. Electives	
Additional courses to complete college requirements	
D. Total (minimum)	120

For further details on the agricultural and biological engineering and technology programs, see the department's undergraduate programs publication, available at 207 Riley-Robb Hall, or contact the field's coordinator of instruction Professor Kifle Gebremedhin for the programs, at 255-2499.

## Animal Sciences

The animal sciences program area offers a coordinated group of courses dealing with the principles of animal breeding, nutrition, physiology, management, and growth biology. Emphasis in subject matter is directed toward domestic animal species, dairy and beef cattle, horses, poultry, pigs, and sheep, while laboratory, companion, and exotic animal species are also included in research and teaching programs. The Animal Science department has extensive facilities for animal production and well-equipped laboratories and classrooms, including a teaching barn, in which students can gain practical experience in the care and management of large animals at a campus location.

The program focuses on the application of science to the efficient production of animals for food, fiber, and pleasure and easily accommodates a variety of interests and goals. Beyond a core of basic courses (suggested minimum, 12 credits) students select production and advanced courses to fulfill an individually tailored program worked out in consultation with their advisers. In this way it is possible to concentrate by species as well as by subject matter (nutrition, physiology, growth biology, breeding, management). For each subject area, supporting courses in other departments are readily available and strongly encouraged. Many science-oriented students elect a program emphasizing supportive

preparation in the physical and biological sciences appropriate to graduate, veterinary, or professional study following graduation. Dairy management is a popular program among students who may be preparing to manage a dairy farm or enter a related career. Other students may elect a program oriented toward economics and business in preparation for a career in the poultry, dairy, meat-animal, horse, feed, or meats industry. These are examples of the flexibility of programs that can be developed to meet a student's career interest related to animals.

It is recommended that students obtain appropriate fieldwork or animal experience during summers. Several special training opportunities exist for highly motivated students. Upperclass students whose academic records warrant it may, by arrangement with individual faculty members, engage in research (either for credit or for Honors) or assist with teaching (for credit). The Dairy Management Fellows program and the Livestock Fellows program offer an equally challenging but different type of experience for a highly select group of students.

## Applied Economics and Business Management

The undergraduate program in applied economics and business management is based in the Department of Agricultural, Resource, and Managerial Economics. Courses in agricultural, resource, and managerial economics are supplemented with others in related areas such as computer science, economics, sociology, history, government, industrial and labor relations, hotel administration, consumer economics, animal sciences, plant sciences, natural resources, mathematics, and statistics.

Six areas of specialization are offered:

**Agribusiness management** is designed for students who have a special interest in the economics and management of businesses that provide services for the agricultural sector of the economy.

**Agricultural and applied economics** provides a general program in the economics of the agricultural sector and of resource use. It is an appropriate major for those students who (1) are interested in applied economics; (2) want to survey offerings in agricultural, resource, and managerial economics, such as management, marketing, economic development, policy, and environmental and resource economics; and (3) want to prepare for graduate work in agricultural economics. It is an appropriate option for those interested in the application of the principles of economics to problems in both the public and private sector.

**Business management and marketing** applies the principles of economics and the tools of management to prepare students for careers in business. Special emphasis is given to developing decision-making skills and to the study of the structure and practices of business institutions. Market analysis, sales, banking, merchandising, production management, and general business management are careers for which students may prepare.

**Environmental and resource economics** provides training for students interested in applying economic concepts to problems of the environment and resource use. A good option for those wishing to take positions as

analysts with agencies that have environmental responsibility or facing environmental regulations.

**Farm business management and finance** is intended for students with farm experience who are interested in farming or in preparing for work in farm management or farm finance, in such positions as Agricultural Lenders, Extensions Specialists, or Consultants.

**Food-industry management** is designed for students interested in management or sales positions with the processing, manufacturing, or distribution segments of the food industry.

All of these areas of specialization can provide a strong foundation for graduate work. In planning a course schedule, students must work closely with their faculty adviser. Each area of specialization has its own unique set of required and recommended courses, yet all the areas have enough flexibility to satisfy the interests and abilities of each individual student.

## Biological Sciences

Biology is a popular subject at many universities for a variety of reasons: It is a science that is in an exciting phase of development; it prepares students for careers in challenging and appealing fields such as human and veterinary medicine, environmental sciences, and biotechnology; and it deals with the inherently interesting questions that arise when we try to understand ourselves and the living world around us. Many of the decisions we face today deal with the opportunities and problems that biology has put before us.

The major in biological sciences at Cornell is offered by the Division of Biological Sciences to students enrolled in either the College of Agriculture and Life Sciences or the College of Arts and Sciences. Student services in the division's Office for Academic Affairs and the Behrman Biology Center are available to students from either college.

The biology major is designed to enable students to acquire the foundations in physical and life sciences necessary to understand modern biology and to pursue advanced studies in a specific area of biology. Programs of study include animal physiology; biochemistry; cell biology; ecology and evolutionary biology; general biology; genetics and development; microbiology; neurobiology and behavior; and plant biology. A special program of study is available for qualified students with an interest in nutrition. Students interested in the marine sciences may consult the Cornell Marine Programs Office (G14 Stimson Hall, 255-3717) for academic advice and career counseling. For more details about the biology curriculum see the section in this catalog on the Division of Biological Sciences.

## Biometry and Statistics

Biometry is the application of mathematical and statistical techniques to the life sciences. Statistics is concerned with quantitative aspects of scientific investigation: design, measurement, summarization of data, and drawing conclusions based on probability statements. Students with ability in mathematics and an interest in its applications will find this a rewarding and challenging major.

The work of a statistician or biometrician can encompass research, teaching, consulting, and computing in almost any mix and in a wide

variety of applications. Opportunities for employment are abundant in universities, government, and businesses ranging from large corporations to small consulting firms; salaries are usually excellent.

While satisfying course requirements for a major in biometry and statistics, students can also take a wide variety of courses in other disciplines. In fact, students are encouraged to take courses in applied disciplines such as agriculture, biology, economics, and the social sciences that involve numerical data and their interpretation.

Students majoring in this area are required to take at least two computer science courses (e.g., Computer Science 100 and 211), mathematics courses (at least three semesters of calculus), and Biometry and Statistics 101, 102, 200, 215, 408-409, 417, 601-602, and 607, and Industrial and Labor Relations 310. Experience gained through summer employment or work as an undergraduate teaching assistant is highly recommended. Students should contact Steven J. Schwager for information.

## Communication

A generation ago, college graduates were thought to be equipped with the knowledge and skills needed to carry them through their entire career. Today we know that the single most important thing we can prepare you for is change.

Upon graduation you will face a world vastly different from the world you lived in when you entered Cornell. The public understanding of our most basic and essential processes such as the production of food and fiber and the development and protection of a sustainable environment becomes more difficult each day. The amount of information we receive and are expected to understand is increasing exponentially.

The public also has become more and more distrustful of science, technology, corporations, and policy makers. It's clear that communication is taking a more central role in all of these areas. Increasingly, government, industry, and special interest groups are relying upon communication specialists to aid in managing information—collecting, sorting, interpreting or reinterpreting, summarizing, and making information accessible to the general public, to special groups, and to decision-makers in organizations. Effective information management requires a thorough understanding of the communication process. Students need to understand that "what we know" is partially determined by "how we found out."

When you graduate from our department, you will have polished the basic communication skills of speaking, writing, and listening. Additionally, you will be prepared for dealing with the changing public climate in many other ways. You will come to understand and be able to communicate, analyze, and synthesize information about the growing complexities of science, agriculture, the environment and health, and public policy.

As a communication major you also will learn about:

- communication processes, such as how communication influences attitudes, opinions, and behaviors

- how communication systems work in our society and in others
- how to apply this understanding of communication to solving problems in government, industry, and education

The communication major is a program with a strong core of contemporary communication knowledge, theory, and practice. Core courses are taken in the freshman and sophomore years (8 courses) and are followed by courses in one or more of the four focus areas of the department. The series of freshman required courses include:

Comm 120	Contemporary Mass Communication
Comm 116	Communication in Social Relationships
Comm 117	Writing about Communication
Comm 121	Investigating Communication

This series of courses will provide you with a basic understanding of communication and the communication process. The courses also provide a unique opportunity to link practical application (such as writing and critical thinking) with up-to-date research and knowledge about communication.

During the sophomore year communication majors will take:

Comm 201	Oral Communication
Comm 230	Visual Communication
Comm 253	Information Gathering and Writing
Comm 282	Applying Communication Knowledge and Methods

After completion of the 8 courses in the core curriculum, you can choose to concentrate your study in one of four focus areas:

- Communication in the Life Sciences. (Studies of the impact of communication on environmental, health, science and agricultural issues, as well as public perceptions of risk.)
- Communication Systems and Technology. (Principles of how we use communication technologies and how we are influenced by these technologies.)
- Communication Planning and Evaluation. (Development of communication plans to solve problems for individuals or for organizations and learning how to evaluate the success of these plans.)
- Communication as a Social Science. (Study of communication research and methods with emphasis on communication as a new social science discipline.)

The department requires that all majors take a 3-credit course in one of the focus areas and an additional 15 credits. Further information on the distribution of these 15 credits will be provided to students in fall 1996.

In designing the communication major, the faculty of the department has kept in mind the necessity for students to understand contemporary research-based knowledge about communication as well as their need to be competent communicators in the workplace and within society at large. Both are critical to successful careers and enlightened citizenship in the 21st century. For students who have specific careers in mind, the department will

have available "pathways," which advisers and students will use to identify courses within and outside the department. The pathways will help guide students toward selected communication careers.

## Education

The focus in the Department of Education is on how teaching and learning take place in school and nonschool settings, as well as on the role of education in our society. Students study concepts and develop competencies necessary to analyze educational situations critically and to plan, implement, and evaluate educational programs. Students in the program area take a core curriculum:

- A course in general psychology (e.g., Psychology 101)
- A course in educational psychology (e.g., Education 311, 317)
- A course in the social and philosophical foundations of education (e.g., Education 271, 370, 378, 472)
- A field experience (e.g., Education 420, 430, 498)

Three specializations and two teacher certification programs are available at the undergraduate level.

**Agricultural, extension, and adult education.** Agricultural, extension, and adult education is a program that combines preparation in both the agricultural and social sciences. The program prepares students for teaching careers in agriculture/biotechnology in public schools, Cooperative Extension and extension and adult programs of agricultural businesses, government agencies, and a variety of private and not-for-profit organizations. Students take a college program that includes a balance of courses in education as well as courses in a technical area of agriculture/biotechnology, community/economic development, natural resources, human ecology, or communication. Education courses in issues in education, teaching and learning, methodology, and instructional applications of microcomputers prepare students to succeed as educators in a broad range of careers. Courses are selected to develop professional leadership and teaching competence. Students may elect to focus their study on one or more of these areas: agricultural education, extension education, or adult education. As an alternative, students may elect to major in one of the college's technical departments and co-advise to prepare in one or more of the three areas of agricultural, extension, and adult education. Further information is available from the agricultural extension and adult education coordinator, Kennedy Hall (Tel: 607-255-2198).

**Educational psychology.** Studies in educational psychology have traditionally focused on teaching and learning in schools. Yet schools are only one location in which learning and teaching take place. An undergraduate emphasis in educational psychology at Cornell applies principles of teaching and learning to educational enterprises, broadly defined.

While graduate study is required for many careers in psychology, an undergraduate emphasis in educational psychology provides excellent preparation for graduate work or for many post-baccalaureate positions. Educa-



tional psychologists develop and/or supervise training programs in business, industry, the military, and government; design and evaluate curriculum and instructional materials for publishers; develop tests for educational and professional associations; evaluate social programs; work in human resource management; and conduct applied research for educational research organizations.

Students interested in concentrating their studies in educational psychology complete a total of 21 hours in educational psychology and related courses. Working with a faculty adviser a student may design a program in one of a variety of applied areas: Instructional Systems Design and Development; Human Relations; Measurement and Evaluation; Individual and Social Development; or the Educational Psychology of Human Development.

Students interested in careers in educational psychology should apply for admission to the Education Department. For more information regarding a concentration in educational psychology, contact: Coordinator, Educational Psychology Program, Education Department, Kennedy Hall.

**General education.** The concentration in General Education provides a solid background in the foundations of education and the opportunity to explore more specialized areas. Students can prepare themselves for graduate programs in areas such as: environmental education; research methods; extension, adult, and continuing education; and the social/economic/legal/philosophical foundations of education. This concentration is appropriate for a variety of careers in nonformal educational settings, human resources, and youth work. Further information is available from the undergraduate coordinator, Kennedy Hall.

## Teacher Certification

**Teacher education in agriculture.** Students completing the Cornell registered program earn grade 7-12 certification to teach agricultural subjects (animal science, plant science, mechanical science, environmental science, and business management), introduction to occupations, occupational science, and occupational mathematics; and the introduction to technology course required for all 7-8th grade students.

A passing grade on the National Teacher Examination (NTE) or Liberal Arts and Science test (LAST); and one year of agricultural work experience are required. Provisional (initial) certification is valid for five years. A master's degree required for permanent certification is offered through graduate study at Cornell.

Students may also be certified to teach selected science subjects (e.g., biology, earth science, and general science) and work as a diversified cooperative education work experience coordinator through direct application to the State Education Department. For more information contact the program coordinator at (607) 255-2198.

**Teacher Education in Science and Mathematics.** Students at Cornell may pursue teaching credentials in biology, chemistry, earth science, general science, mathematics, and physics. Teacher Education in Science and Mathematics (TESM) is a university program jointly conducted by the departments of Education and Mathematics.

TESM students who begin the program as juniors or seniors complete their undergraduate major and five education courses. TESM students come from a number of different majors offered at Cornell, including Animal Science, Biometry and Statistics, and Engineering. In a fifth year of study, TESM students do student teaching and take additional science and/or mathematics courses. Students earn the Master of Arts in teaching degree for this graduate study. Students who complete the TESM program and pass the required New York State tests are eligible for provisional certification in New York State. The masters degree is required for permanent certification in New York State. Students can also begin the TESM program at the graduate level.

For more information, contact the TESM Student Support Specialist at (607) 255-9255 or the program coordinator, D. J. Trumbull (607) 255-3108.

## Entomology

The entomology curriculum provides students with a basic background in biological and environmental sciences, with a special emphasis in the study of insects. Majors may pursue graduate studies in entomology or related sciences upon completion of the B.S. degree. Alternatively, students may immediately begin careers in various aspects of integrated pest management. Because of this diversity of career options, the major includes a common core of requirements allowing flexibility in electives selected by students in consultation with their advisers.

### Specific Requirements

#### Basic Sciences

College mathematics, including a course in calculus  
A year of physics  
Chemistry 103-104 or 207-208  
Chemistry 253 (organic)

#### General Biology

Introductory Biology  
Biological Sciences 281, Genetics, or Plant Breeding 225, Plant Genetics  
A choice of one: Biological Sciences 261, Principles of Ecology **or**  
Biological Sciences 330 or 331, Principles of Biochemistry **or**  
Biological Sciences 378, Evolutionary Biology

#### Entomology

Entomology 212, Insect Biology  
Entomology 322, Insect Morphology  
Entomology 331, Introductory Insect Systematics  
Entomology 483, Insect Physiology

It is strongly recommended that students who wish to undertake graduate training in entomology include course work beyond the minimum in their program, including enrollment in more than one of the general biology courses; i.e., ecology, biochemistry, and evolutionary biology. Students interested in pest management may include courses such as Entomology 241, Applied Entomology, Entomology/Plant Pathology 444, Integrated Pest Management, or other appropriate specialized courses.

## Food Science

The mission of the Food Science Program is to educate students for careers in food science

and technology. Graduates are prepared for entry level positions in industry, government, and research organizations or for advanced study in food science and related disciplines. Food scientists qualify for satisfying careers which focus on ensuring the sustainable availability of a safe, nutritious, affordable, and high quality food supply for people throughout New York State, the nation, and the world.

Students choose one of five specialization options: 1) Basic Food Science, 2) Food Engineering, 3) Food Processing, 4) Food Industry Operations and Management, 5) International Food Development. The first three options meet minimum curriculum standards set by the Institute of Food Technologists, the premier professional society for food scientists. Students choose an option based on individual interests and career goals. The choice should be made as early as possible.

The first two years of the program are focused on establishing a solid background in the physical and biological sciences, math, and communication. Required courses include chemistry (intro and organic), biology, microbiology, calculus, physics, freshman seminar, food science, and nutrition. The second two years emphasize the application of basic science and technology to the processing, storage, distribution, marketing, and final preparation of foods. Required courses include Food Engineering Principles, Unit Operations in Food Manufacturing, Food Safety Assurance, Food Chemistry, Sensory Evaluation of Foods, Food Microbiology, and statistics. Students choose electives to satisfy college distribution requirements and individual interests.

Students are strongly encouraged to participate in research supervised by a faculty member and/or to work as an intern in a food company during summers. Most faculty in the department have active research programs and welcome participation by undergraduate students. Students may receive academic credit or wages for undergraduate research on campus. Many food companies recruit on campus for their summer internship programs. These internships are excellent opportunities for students to gain experience and establish contacts for future employment.

A state-of-the-art food processing and development laboratory, a full-scale dairy plant, and extensive laboratory facilities are available on campus for training, research, and employment.

## Landscape Architecture Program

The Landscape Architecture Program focuses on the art of landscape design as an expression of cultural values combined with natural processes of the ambient environment. The program's unique place within the university promotes interaction among the areas of horticulture, architecture, and city and regional planning. The program is co-sponsored by the colleges of Agriculture and Life Sciences and Architecture, Art, and Planning.

The program offers a course of study that prepares students intellectually, technically, artistically, and ethically for the practice of landscape architecture. The curriculum focuses on graphic communication, basic and advanced design methods, landscape history, plant materials, construction technology,

theory, and professional practice. Design studios deal with the integration of cultural and natural systems requirements as applied to specific sites at varying scales. Projects range from urban design and housing to parks and garden design.

The Landscape Architecture Program offers two professional degree alternatives: a four-year Bachelor of Science degree administered through the College of Agriculture and Life Sciences; a three-year Master of Landscape Architecture degree administered through the Graduate School for those who have a four-year undergraduate degree in another field. Both of these degrees are accredited by the Landscape Architecture Accreditation Board (LAAB) of the American Society of Landscape Architects.

The program also offers a two-year Master of Landscape Architecture Advanced Degree Program administered through the Graduate School, for those with accredited degrees in Landscape Architecture or Architecture. The two-year program entails developing concentrations in subject matter areas such as landscape history and theory, landscape ecology and urban horticulture, the cultural landscape, site/landscape + art, or urban design.

In addition, an undergraduate concentration in the American Cultural Landscape is available for nonmajors.

#### Dual Degree Options

Graduate students can earn a Master of Landscape Architecture and a Master of Science (Horticulture) or a Master of City and Regional Planning simultaneously. Students need to be accepted into both fields of study to engage in a dual degree program and must fulfill requirements of both fields of study. Thesis requirements are generally integrated for dual degrees.

#### Study Abroad

The faculty encourages study abroad and has two formally structured programs. The *Denmark International Study* (DIS) program is available primarily to senior undergraduates in the fall semester and is administered through Cornell Abroad. The *Rome Program* is made available to undergraduates and graduate students through the College of Architecture, Art, and Planning.

#### Bachelor of Science Landscape Architecture Degree Sequence:

##### First Year

<i>Fall Term</i>	<i>Credits</i>
*LA 141, Grounding in Landscape Architecture	4
†Biological sciences elective	3
†Physical sciences elective	3
†Social sciences or humanities elective	3
†Written or oral expression elective	3
	<hr/> 16

##### Spring Term

*LA 142, Grounding in Landscape Architecture	4
†Biological sciences elective	3
†Social sciences or humanities elective	3
†Written or oral expression elective	3
‡Free elective	2
	<hr/> 15

##### Second Year

###### Fall Term

*LA 480, Principles of Spatial Design and Aesthetics	3
*LA 201, Medium of the Landscape	6
††Free elective	3
*HORT 335, Woody Plant Materials for Landscape Use	3
	<hr/> 15

###### Spring Term

*LA 202, Medium of the Landscape	6
*LA 315, Site Engineering I (1st 7 weeks)	2
*LANAR 524, History of European Landscape Architecture	3
†Written or oral expression elective	3
†Physical sciences elective	3
	<hr/> 17

##### Third Year

###### Fall Term

*LA 301, Integration of Realities	6
*LA 316, Site Engineering II (2nd 7 weeks)	2
*LA 317, Site Construction I (1st 7 weeks)	2
*LANAR 525, History of American Landscape Architecture	3
*LA 491, Planting Design and Establishment	3
	<hr/> 16

###### Spring Term

*LA 302, Integration of Realities	6
†Biological Sciences Elective	3
†Physical sciences elective	3
*LA 318, Site Construction II (2nd 7 weeks)	2
	<hr/> 14

##### Fourth Year

###### Fall Term

*LA 401, Advanced Synthesis: Project Design	6
†Social sciences or humanities elective	3
‡Free elective	5
(Optional landscape architecture study abroad semester in Denmark or Rome)	14
	<hr/> 14
<i>Spring Term</i>	
*LA 402, Advanced Synthesis: Urban Design	6
†Social sciences or humanities elective	3
*LA 412, Professional Practice	1
*Menu Option	3
	<hr/> 13

##### Summary of credit requirements

*Specialization requirements	71
†Distribution electives	39
‡Free electives	10
	<hr/> 120

#### Master of Landscape Architecture (M.L.A.) License Qualifying Degree

Requirements of the three-year M.L.A. curriculum include 90 credits, and 6 resident units satisfactory completion of the core curriculum courses, and a thesis.

##### First Year

<i>Fall Term</i>	<i>Credits</i>
*LA 505, Graphic Communication I	3
*LA 480, Principles of Spatial Design and Aesthetics	3
*LA 501, Composition and Theory	6
*HORT 335, Woody Plant Materials for Landscape Use	3
*LANAR 520, Contemporary Issues in Landscape Architecture	2
	<hr/> 17

###### Spring Term

*LA 502, Composition and Theory	6
*LANAR 524, History of European Landscape Architecture	3
*LA 506, Graphic Communications II	3
*LA 615, Site Engineering I (1st 7 weeks)	2
‡Free elective	2
	<hr/> 16

##### Second Year

###### Fall Term

*LA 601, Context and Landscape/Integration of Reality	6
*LA 616, Site Engineering II (2nd 7 weeks)	2
*LA 617, Site Construction I (1st 7 weeks)	2
*LANAR 525, History of American Landscape Architecture	3
*LA 491, Planting Design and Establishment	3
	<hr/> 16

###### Spring Term

*LA 602, Context and Landscape/Integration of Reality	6
*LA 618, Site Construction II (2nd 7 weeks)	2
‡Free elective(s)	7
	<hr/> 15

##### Third Year

###### Fall Term

*LA 590, Theory Seminar	3
*LA 701, Urban Design and Planning	6
‡Free elective	5
	<hr/> 14

*Spring Term*

*LA 800, Master's Thesis in Landscape Architecture (or LA 702, Advanced Design Studio and elective worth 3 credits)	9
*LA 412, Professional Practice	1
‡Free elective(s)	2
	12
<i>Summary of credit requirements</i>	
*Specialization requirements	74
‡Free electives	16
	90

**Master of Landscape Architecture**

**Advanced Degree Program.** The two-year Master of Landscape Architecture (M.L.A./A.D.) program serves to broaden and enrich undergraduate education in design by providing an expanded educational experience to those who are technically skilled. Applicants are therefore expected to hold a Bachelor's Degree in Landscape Architecture or Architecture from an accredited program.

The objective of the two-year (M.L.A./A.D.) program is to develop specializations for individuals who may wish to teach, practice, or conduct applied research in landscape architecture. Students are permitted some flexibility in establishing programs that take full advantage of the teaching and research resources of the university.

Students admitted to the two-year M.L.A./A.D. program are required to complete 60 credits of course work as approved by the members of their graduate committee. This must include at least two advanced studios, a graduate seminar, a concentration, and a thesis.

**Undergraduate Concentration for Non-Majors**

Students outside the professional program may choose the undergraduate concentration in the American Cultural Landscape to complement their major. The courses center on the landscape as an object, something to be studied for its own sake, and as a subject, as a means to understand society and its relationship to natural systems and diverse cultures. The cultural landscape includes its visible elements as well as perceptions and cultural ideas and values. The concentration consists of five courses, two required and three elective. Students may petition to substitute one course in the electives list. Direct inquiries to professors H. Gottfried or S. Baugher.

Required.

**Visual Studies (choose one):**

- Arch 11 Introduction to Architectural Design (4 cr)
- Art 121 Introduction to Painting (3 cr)
- Art 141 Introduction to Sculpture (3 cr)
- Art 151 Introduction to Drawing (3 cr)
- Art 158 Conceptual Drawing (3 cr)
- Art 159 Life and Still-Life (3 cr)
- Art 161 Photography I (3 cr)
- DEA 101 Design I: Fundamentals (3 cr)
- DEA 114 Drawing (3 cr)
- LA 141 Freehand Drawing (3 cr)

**The Landscape**

- +LA 282 The American Landscape (3 cr)

**Electives (choose three):**

- +LA 261 Urban Archaeology (3 cr)
- +LA 262 Laboratory in Landscape Archaeology
- +LA 360 Pre-Industrial Cities and Towns of North America (3 cr) offered alternate years [1995-96/1997-98]
- LA 363 American Indians, Planners, and Public Policy (3 cr)
- LANAR 521 History of American Landscape Architecture (3 cr)
- LA 569 Archeology in Site Design and Planning (3 cr) offered alternative years [1996-97]

+Distribution Elective

**Natural Resources**

The undergraduate curriculum is designed to provide an enduring and broadly applicable education. The focus of study is on the systems that yield our renewable natural resources (water, forests, fish, and wildlife) and includes emphasis on both the ecological and human dimensions of resource management. Students are encouraged to understand the scientific, ethical, and societal basis for the protection and management of renewable resources through the application of ecological principles and knowledge of social needs.

**Required Core Curriculum**

Students who desire to graduate with a specialization in Natural Resources are expected to complete, as a minimum, the courses specified in the following two-part Core Curriculum. First is a broad group of courses taken primarily outside the department, which, as their presentation suggests (Groups A-D), also fulfill this college's course distribution requirements described on page 30.

**Group A - Physical Sciences** *Total Hours*

- Mathematics - 2 courses 6-8
- Chemistry - 2 courses 7-8

**Group B - Biological Sciences**

- Introductory biology - 8 cr. hours 8
- General ecology - 1 course 4

**Group C - Social Sciences**

- 3 credits in addition to
- 3 credits in economics 6

**Humanities**

- 6 credits in addition to a course in "normative" ethics (NTRES 407, or PHIL 241, 246, or 247) 9

**Group D - Written and Oral Expression**

- Freshman Writing Seminars - 2 courses 6
- Oral communications - 1 course 3

**Courses outside the Distribution Groups**

- Statistics - 1 course 3
- Computer applications or programming - 1 course 3

The Core Curriculum's second portion is composed entirely of courses offered by the Department of Natural Resources; a minimum of 19 hours in department courses is required.

**YEAR 1***Total Hours*

**One of 2** introductory courses: 3

NTRES 100 Principles of Conservation (Fall, 3 cr.)

NTRES 201 Environmental Conservation (Spr., 3 cr.)

**YEAR 2**

both courses listed:

NTRES 210 Introductory Field Biology (Fall, 4 cr.) 4

NTRES 253 Applied Ecology and Ecosystem Management (Spr., 3 cr.) 3

**YEARS 3 AND 4**

At least 9 credit hours from the following courses, with a minimum of 3 credit hours in ecology and 3 credit hours in management.

Course	Ecology Credit	Management Credit
NTRES 301 Forest Ecology—Lecture	3	
NTRES 302 Forest Ecology—Lab	1	
NTRES 303 Woodlot Management		3
NTRES 304 Wildlife Ecology Concepts	1	
NTRES 305 Wildlife Ecology/Applications	1-2	
NTRES 308 Natural Resources Management	3	
NTRES 350 Global Dimensions of Ecological Change	3	
NTRES 401 Env. and Nat. Res. Policies	3	
NTRES 402 Nat. Res. Policy, Planning & Politics	3	
NTRES 404 Wildlife Population Concepts	1	
NTRES 405 Wildlife Population Applications		1-2
NTRES 410 Wildlife Management Concepts & Applications		3
NTRES 415 Agroforestry		2
NTRES 418 Wetland Ecology & Management—Lecture	2	1
NTRES 419 Wetland Ecology & Management—Laboratory		1
NTRES 438 Fishery Management		3
NTRES 442 Techniques in Fishery Science		5
NTRES 450 Conservation Biology	2	1
<b>Total Credit Hours</b>	<b>(3 min)</b>	<b>(3 min)</b>
	<b>(9 minimum total)</b>	

Students pursuing this specialization have remaining approximately 40 credit hours available to develop one or more concentrations of their choice within or outside this field.

Students who wish to do so may specialize further in natural resource ecology and management (including wildlife, fishery, forest, and aquatic sciences), or natural resource policy, management, and human dimensions.

Opportunities for field-oriented studies are available at Cornell's nearby Arnot Teaching and Research Forest, the Cornell Biological Field Station on Oneida Lake near Syracuse, as well as at numerous natural areas near campus.

Students should seek relevant work experience to complement their academic studies.

### Nutrition, Food, and Agriculture

Nutritional sciences draws upon chemistry, biology, and the social sciences to understand complex relationships among human health and well-being, food and lifestyle patterns, food and agricultural systems, and social and institutional environments.

The program in nutrition, food, and agriculture provides students with strong training in human nutrition in the context of an understanding and appreciation of the agricultural and life sciences. The program responds to the growing and important interrelationships between human nutrition and the agricultural and life sciences. Growing public interest in health and nutrition has placed new demands upon food producers, processors, and retailers. The problems of hunger and malnutrition in the United States and abroad require that nutritionists work together with specialists in areas such as agricultural economics, food production, and rural sociology. Advances in biotechnology provide researchers with new ways to understand human nutritional requirements and the regulation of human metabolism.

Nutrition, food, and agriculture majors complete a core set of requirements and choose elective courses in the areas of their particular interest. The core curriculum includes introductory chemistry and biology, organic chemistry, biochemistry, physiology, and mathematics. Students complete five courses in nutritional sciences: NS 115 Nutrition and Health Concepts and Controversies, NS 245 Social Science Perspectives on Food and Nutrition, NS 345 Nutritional and Physicochemical Aspects of Foods, NS 331 Physiological and Biochemical Bases of Nutrition, and NS 332 Methods in Nutritional Sciences. In addition, students select a minimum of three advanced courses in nutritional sciences as well as elective courses in the broad areas of food production and processing, food and agricultural policy, and the life sciences.

All majors have faculty advisers in the Division of Nutritional Sciences with whom they meet regularly. Advisers help students plan course schedules and help find opportunities for special study or experiences outside the classroom.

Many students engage in laboratory or field research with a faculty member for academic credit. The honors program is designed for academically talented students who are interested in research. Honors students conduct independent research projects under the guidance of a faculty member and prepare an honors thesis. Many students participate in field experiences for credit during the

academic year or summer. Placements in laboratories, industries, or community agencies are possible.

The major in nutrition, food, and agriculture can lead to many different career paths. By supplementing the core requirements with courses in different areas, students can prepare for jobs in industry, government, or community agencies in the United States or abroad. The major is excellent preparation for graduate study in a variety of fields.

The Division of Nutritional Sciences is affiliated with both the College of Agriculture and Life Sciences and the College of Human Ecology. Most of the Division faculty members work in Savage Hall and Martha Van Rensselaer Hall. In addition to housing offices, classrooms, and seminar rooms, these buildings contain research facilities, specialized laboratories, a human metabolic research unit, and computer facilities. The nutritional sciences Learning Resource Center in Martha Van Rensselaer Hall is used by students for study and small group discussion. The center contains class materials, audiovisual aids and supplementary books and periodicals for independent study and special projects.

For additional information about the nutrition, food, and agriculture program, contact the Division of Nutritional Sciences Academic Affairs Office, 335 MVR, 607-255-2628.

### Plant Sciences

Plant sciences students can specialize in plant biology, plant genetics and breeding, plant pathology, plant protection, or horticultural sciences, including floriculture and ornamental horticulture, and fruit and vegetable science. Students with well-defined interests upon arrival at Cornell can specialize in one of these programs beginning as freshmen. Others may prefer to start in the general plant sciences curriculum and specialize after exploring the program offerings.

Plant sciences is a multidepartmental program, sponsored by the Department of Plant Breeding in Emerson Hall, and the Departments of Floriculture and Ornamental Horticulture, Fruit and Vegetable Science, Plant Pathology, and the Section of Plant Biology, all located in the Plant Science Building.

**General plant science** is intended for students whose interest in studying plants has not yet centered on any one of the specializations within the area. Students may continue with this option throughout their undergraduate years, particularly if they are likely to be interested in and qualified for advanced studies beyond the bachelor's degree. Students who plan to seek employment upon graduation may prefer to specialize. There are, however, excellent opportunities for general plant science graduates at the bachelor's degree level in the service and supply industries, as Cooperative Extension agents, as teachers, and as research technicians.

More than one hundred courses are offered that deal directly with some area of plant science. Other courses relating to plant science are offered in other departments. In addition, an interest in plant science may be combined with another specialization, such as agricultural and biological engineering, education, statistics, international agriculture,

food science, or agricultural, resource, and business management.

Undergraduates are encouraged to obtain practical experience, which may involve internship and/or research under the direction of a faculty member or work in a commercial industry, research institute, botanical garden or arboretum, nursery, greenhouse, or farm operation. Departments will assist students in finding positions that will provide useful experience.

**Floriculture and ornamental horticulture** applies principles of plant science and business management to the production and marketing of florist, nursery, and turfgrass crops, as well as to the selection and management of plants for both indoor and outdoor landscapes. Programs prepare students for careers at the professional and managerial levels in horticultural business, botanical gardens and arboreta, research, teaching, communications, and extension and public education.

The core curriculum consists of the following courses:

BIO G 109 and 110, Biological Principles or an equivalent course  
CHEM 103 and 104 or 207 and 208 or an equivalent course  
HORT 101, Introduction to Horticultural Science  
HORT 102, General Horticulture  
HORT 230, Woody Plant Materials  
HORT 243, (BIO PL 243), Taxonomy of Cultivated Plants  
HORT 300 and 301, Garden and Interior Plants I and II  
HORT 400, Principles of Plant Propagation  
BIOPL 241, Plant Biology (Introductory Botany)  
BIOPL 242, Plant Physiology (lecture)  
BIOPL 244, Plant Physiology (laboratory)  
SCAS 260, Introduction to Soil Science  
ENTOM 241, Applied Entomology  
PLPA 241, Plant Diseases and Disease Management or PL PA 401, Basic Plant Pathology  
Although mastery of these subject areas is considered essential for students planning to enter a floriculture or landscape horticulture career, justifiable exceptions to the core curriculum may be granted by the student's adviser.

With permission of the adviser, a transfer student may receive core curriculum credit for similar courses taken at other institutions provided that transfer credit is granted by the College of Agriculture and Life Sciences. In addition, all transfer students must complete a minimum of 12 credits in floriculture and ornamental horticulture courses at Cornell. No more than two of the following landscape architecture courses may be included in this 12-credit requirement: LA 142, 282, 315, 316, 317, 318, 410, 480, 491. No other landscape architecture or freehand drawing courses may be applied to the requirement because they do not contain horticultural subject matter.

Students may select an area of emphasis in either floriculture or landscape horticulture, or they may study generally across the specialization. Concentration in floriculture prepares students for careers in management of florist and greenhouse crop production, crops in controlled environment agriculture, and wholesale- and retail-florist marketing. Specialization in landscape horticulture trains



students for careers in nursery-crop production, turfgrass management, exterior and interior landscape contracting and service, retail- and wholesale-marketing of nursery products and services, public and botanical garden and arboretum management, urban horticulture, and related areas. Some students choose to pursue a general program in floriculture and landscape horticulture including courses in both areas. Similarly, programs in horticultural business management, research, teaching, extension and public education, and communications/journalism may be arranged across two specialization areas. Students wishing to prepare for graduate study in horticultural science may develop a program in basic sciences and their application in horticultural science. Lists of recommended courses for the areas of specialization are available from student advisers and from the undergraduate program coordinator.

Working with his or her faculty adviser, each student will tailor a program to achieve individual educational objectives in floriculture, landscape horticulture, horticultural business management, or general horticultural science. A core of management courses also is strongly recommended for students planning horticultural business careers.

Students are also encouraged to take courses in these areas: agricultural and biological engineering, soil science, computer science, ecology, entomology, geology, plant breeding, plant pathology, plant physiology, oral and written expression, plant taxonomy, and weed science. Use of electives to pursue study in the humanities and in other areas of special interest to the student is encouraged.

Numerous opportunities to become familiar with the horticultural industries and professions are provided through field trips, guest lectures, undergraduate seminars, independent or small-group study, optional internships, and work-experience programs.

Questions concerning the undergraduate curriculum, advising, and related matters should be addressed to Professor Carl F. Gortzig, Undergraduate Program Coordinator, Department of Floriculture and Ornamental Horticulture, 23 Plant Science Building, Ithaca, New York 14853-5908 (telephone: 607-255-1787).

The department's office is 20 Plant Science Building. Departmental facilities include classrooms and laboratories in the Plant Science Building, greenhouse and laboratory facilities at the Kenneth Post Laboratory, the Test Garden, the Turfgrass Research Field and Laboratory, landscape architecture studios on the fourth floor of Roberts Hall (entrance Kennedy Hall), and freehand drawing studios in Mann Library.

**Plant biology** provides undergraduates with preparation for graduate study in the plant sciences that stresses basic, rather than applied, research. In cooperation with an adviser, each student plans a curriculum with a concentration in basic sciences supplemented by courses in applied areas that seem appropriate. Options include molecular biology, plant physiology, plant biology, genetics, cytology, organic chemistry, biochemistry, anatomy, taxonomy, ecology and evolution, and statistics. A core of courses, including mathematics, plant biology and physiology, and cytology, is strongly suggested. However, different specialties

within plant biology afford a flexible curriculum.

**Plant genetics and breeding** provides undergraduates with (1) preparation for graduate study leading to advanced degrees in plant breeding and plant genetics and (2) preparation for work in producing and marketing plant varieties and making varietal recommendations, for positions in seed analysis, regulation, and quality control, and for work in biotechnology laboratories.

In cooperation with an adviser, each student plans a curriculum with a concentration in basic sciences supplemented by courses in applied fields best suited to his or her individual goals. Options include plant breeding and plant genetics; genetics, cytology, and cytogenetics; statistics; organic chemistry and biochemistry; plant anatomy, ecology, taxonomy, and physiology; crop production; plant pathology; entomology; and molecular biology and biotechnology.

Students are encouraged to gain hands-on experience in plant genetics and breeding by conducting independent research under direction of a faculty advisor and/or by working for a faculty member on his/her research. Field, greenhouse, and laboratory facilities are available.

**Plant pathology** is the study of the causes of plant diseases, the mechanisms of the interactions of disease-causing agents and plants, and the methods of preventing or controlling plant diseases. For most students, a concentration in plant pathology as an undergraduate is preparation for graduate study in plant pathology or another field of plant science. However, this concentration also prepares students for careers as technical representatives for agribusiness, as cooperative extension agents, as state or federal regulatory agents, or as research technicians in laboratories of plant pathology, mycology, microbiology, and biotechnology.

Courses include chemistry, mathematics, introductory biology, botany, plant physiology, and introductory plant pathology. Additional plant pathology courses and other relevant courses from other fields are selected according to the particular interests of the student. Options include entomology; plant breeding; pomology; vegetable crops; floriculture and ornamental horticulture; and soil, crop, and atmospheric sciences.

**Plant protection** is offered for students who are interested in the management of plant pests. It includes the study of insects, diseases, weeds, vertebrate pests, and other factors that prevent maximum crop production. This concentration can prepare students for careers in agribusiness, the agrichemical industry, cooperative extension, pest management consulting, state and federal regulatory work, and a variety of other technical positions. Although designed as a terminal program for students desiring a practical preparation in general plant protection, this specialization can also provide an adequate background for graduate work in entomology, plant pathology, or weed science.

The following subjects are considered essential to the plant protection specialization: botany and plant physiology, general ecology, soils, crop science, and microbial ecology. Additional courses in introductory entomol-

ogy, introductory plant pathology, plant disease control, weed science, and integrated pest management are recommended.

In addition, a number of other subjects pertinent to plant protection are recommended, depending upon the student's interests: agricultural economics, agricultural and biological engineering; soil, crop, and atmospheric sciences; biochemistry; communication; pathology and entomology; general physics; genetics; meteorology; mycology; pesticides in the environment; and plant anatomy. Employment involving practical experience in plant protection between the junior and senior years is encouraged. The job may be on a farm, at an experimental station, with an agrichemical company, or with a regulatory agency.

**Pomology** (the science of fruit growing) provides students with knowledge of the scientific technology and the influence of environmental factors on the production, handling, and storage of deciduous fruit crops. New York is a national leader in fruit production.

Courses are selected by students in consultation with a faculty adviser. Flexibility in programs makes it possible to establish a course of study to fit the desired goals of individual students. The diverse pomology curriculum, complemented by courses in basic sciences and arts and electives in a student's area of interest, prepares pomology majors for a career in fruit production, agricultural business related to the fruit industry, storage and merchandising, or professional pomology. Job opportunities for graduates can be found in fruit production, marketing, sales and service, research, teaching, and extension.

**Vegetable crops** is offered for students with an interest in either applied or basic aspects of vegetable production. The high value of vegetables and their importance in the human diet assures a continued demand for trained personnel in all aspects of vegetable technology. A flexible curriculum is provided to prepare undergraduates for careers in a diversity of fields, including: horticultural research, teaching, extension, production, processing, and marketing. A faculty adviser assists individual students in the selection of courses, which usually include: general horticulture, soils, botany, vegetable types and identification, vegetable production, and post-harvest handling or marketing. Additional course work depends upon the interest of the student, and may include: vegetable physiology; plant breeding; entomology; plant pathology; weed science; ecology; soil, crop, and atmospheric sciences; nutritional science; agricultural economics; international agriculture; and agricultural and biological engineering.

The vegetable industry is an economically important component of agriculture in New York and in the United States. Recently, there has been increased interest in growing vegetables in tropical countries. Exciting challenges are facing the industry. Greater awareness of environmental and health issues is driving a change toward farming practices that depend less upon agricultural chemicals than in the recent past. New technologies are being developed and implemented to help growers make this change while remaining profitable. Among these technologies are: integrated pest management, genetic engineering, breeding for insect and disease

resistance, low-input and organic cropping systems, and cultural practices that improve production efficiency and conserve agricultural resources.

The Department of Fruit and Vegetable Science has on-campus greenhouses and laboratories as well as two research farms in the Ithaca area that support our teaching program. Students are encouraged to gain hands-on experience growing vegetables and to pursue their individual interests through course work and by taking advantage of the many resources available in the College of Agriculture and Life Sciences.

### Rural Sociology

Technological, economic, demographic, and environmental changes are social processes, and each has major impacts on individuals, social groups, societies, and the international order. At Cornell, rural sociology students study these and other facets of social change in both domestic and international settings. Among the topic areas in which faculty members in the Department of Rural Sociology specialize are international agricultural and rural development, community and regional development and changes in the United States, environmental sociology, aging and the life course, sociology of agriculture, rural industrialization and labor markets, technology and social change, population and development, political economy, women in development, race and ethnic relations, and research methodology. Most courses provide background in both domestic and international aspects of the subject matter. Normally, students will develop a specialization with either a domestic or international emphasis by choosing appropriate elective courses. All students learn the theory and methodology of sociology, and how to apply both to research and policy in their subject areas.

Recognizing that students are concerned with future career opportunities, the undergraduate program emphasizes acquisition of skills as well as general knowledge in preparation for jobs or further study upon graduation. Accordingly, students are expected to become involved in the application of theory, methodology, principles, and concepts in the analysis of practical problems.

Rural sociology offers degree programs at both the undergraduate and graduate levels (B.S., M.S., M.P.S., or Ph.D.). These programs are offered through the Department of Rural Sociology and the Graduate Field of Development Sociology, both of which are located in Warren Hall. For many years, the department and graduate field have been recognized as among the top programs in the country, and both are known for innovative program orientations. The department is particularly well known for providing instruction in international as well as domestic aspects of community and rural development, environmental sociology, sociology of agriculture, population studies, and other topics. Faculty members in this department are committed to both quality instruction and research programs. Being located in a college of agriculture, faculty members maintain strong ties with the technical fields in the college as well as with the International Agriculture Program, the Biology and Society Program, the Cornell Institute for Social and Economic Research, the Community and Rural Develop-

ment Institute, the Gender and Global Change Program, the Life Course Institute, the Rural Development Program, the Hispanic Studies Program, the Program on Science, Technology, and Society, and the Center for International Studies. Nearly half of the department faculty are associated with one or more area studies programs (the Southeast Asia Program, South Asia Program, Latin American Studies Program, East Asia Program, or the Institute for African Development). Department members also maintain working relations with faculty in the Department of Sociology and other social science units located in other colleges at Cornell. Students are encouraged to supplement their course work by electing courses in these other departments and programs, thereby rounding out their educations by acquiring different perspectives.

The courses offered in rural sociology can be grouped in three broad categories: development sociology; population, environment, and society; and social data and policy analysis. All students majoring in Rural Sociology are required to take five core courses: an introductory course (R SOC 101), methods (R SOC 213), theory (R SOC 301), social stratification (R SOC 370), and a course in statistics. Four elective Rural Sociology courses are also required of all majors.

**The focus area in development sociology** provides an understanding of the processes and policies that influence social and economic development in rural settings in North America and low-income countries in the developing world. Courses provide background in the sociology of development in both the advanced and developing countries. Students normally select a set of elective courses in which either domestic or international development is emphasized. These courses provide background in several aspects of development sociology, including (1) an understanding of the processes of socioeconomic development in low-income or Third World countries and training in the formulation of strategies to enhance the socioeconomic well-being of citizens of those countries, (2) analysis of the social structures and processes for development in nonmetropolitan settings in the United States, (3) analysis of the processes of agricultural change and development in industrialized and low-income countries, and (4) an understanding of the processes of technological development and change in agriculture and other rural industries in developed and developing countries.

Students are encouraged to complement courses in the department with course work in the history and economics of development, area studies, and the policy sciences.

**Courses in the population, environment, and society focus area** provide an understanding of (1) the causes and consequences of the major components of population change—fertility, mortality, and migration; (2) the major patterns of population distribution and population characteristics in the United States and the developing world, (3) the relationships between social structure and the biophysical environment, (4) the relationships between population change and natural resource utilization in development, and (5) impacts of public policy interventions on population size, growth and composition or on natural resource availability and environmental quality. Students normally

select the elective courses for the major in such a way as to stress either population studies or sociological aspects of natural resources and the environment.

Students are encouraged to complement courses in the department with course work in demographic methods, household analysis, ecology and evolution, environmental studies, natural resources, and policy sciences.

**Courses in the social data and policy analysis focus area** provide (1) knowledge of research methodology, statistics, and computer applications, (2) an understanding of social, economic, political, and historical concepts essential for conducting meaningful analyses of practical problems and issues faced by organizations, communities, regions, and states, and (3) knowledge and practice in policy analysis. Students ordinarily select electives in order to specialize in either policy analysis or in a particular area of public policy (international development policy, domestic rural development policy, environmental policy, or population policy, etc.).

Students are encouraged to complement courses in the department with course work in data collection and research design, evaluation research, computing, and advanced statistics.

### Soil, Crop, and Atmospheric Sciences

The Department of Soil, Crop, and Atmospheric Sciences provides instruction in five specializations: atmospheric science, agronomy, crop science, science of earth systems, and soil science. Employment opportunities are increased with practical experience, and the faculty of the department and the Career Development office of the college are glad to help students search for relevant summer jobs and internship opportunities. Professional certification can also be obtained in some of these specializations.

**Atmospheric science** is the study of the atmosphere and the processes that shape our weather. The core curriculum in meteorology is designed to provide students with an understanding of the fundamental physical and dynamic properties and processes of the atmosphere. All students are required to complete a minimum of five semesters of calculus; two semesters of physics; a semester each of chemistry, computer science, and statistics; and a sequence of eight courses covering observational, general, theoretical, and synoptic meteorology. Additional courses are available for students interested in specialized areas of meteorology. The curriculum satisfies the basic requirements for employment as a professional meteorologist and provides a sound background for graduate study or work in the numerous specialized areas of meteorological science. Students are encouraged to choose additional course work in related or complementary areas of interest, such as agriculture, biology, computer science, mathematics, statistics, physics, chemistry, or engineering.

**Agronomy** combines the study of crop production and soil management. It provides the student with a broad array of career opportunities after completion of the B.S. degree, including agricultural business, extension service work, and farming. Graduate school can also follow a well-planned program. The student should take at

least 12 credits of crops and 12 credits of soils and design the remainder of his or her curriculum to meet specific interests and goals. Some students pursue a double major in agronomy and international agriculture.

**Crop science** is the application of basic biological and ecological science to the improvement and management of the world's main field crops used for human food and livestock feed. Courses required include 18 credits of crops, 12 credits of plant biology, and 6 credits of soils. Students who anticipate a career in agricultural production or service after completion of the B.S. degree should take additional courses in economics, communication, plant pathology, entomology, and nutrition. Students planning graduate or professional study beyond the bachelor's degree should take advanced course work in organic chemistry and biochemistry, calculus, physics, and statistics.

**Science of Earth Systems** integrates atmospheric and soil science as well as other earth studies to develop a scientific basis for managing the basic resources of the planet. This is an interdisciplinary program described in detail elsewhere (see index).

**Soil science** is a basic discipline important in ecology, engineering, agriculture, and conservation. The curriculum in soil science combines physical and biological training to address critical issues in environmental and agriculture management related to soils. Students take 18 credits in soil science, including 4 credits in the introductory course. In addition, chemistry, mathematics, physics, and microbiology are required, as well as 6 credits of crop science to satisfy the major.

### Special Programs in Agriculture and Life Sciences

Some students are interested in pursuing a general education in the agricultural sciences. Others are uncertain about career objectives in agriculture and the life sciences. The opportunity to develop an independent major in general studies in agriculture and the life sciences is available for such students. In consultation with a faculty adviser, they may plan a sequence of courses suited to their individual interests, abilities, and objectives in an area not encompassed by the existing programs. In addition to the distribution and other college requirements, this major may include a concentration of courses in one or several academic units of the university.

Students completing this major are often planning a career in agriculturally related food and service enterprises. Many of the fast-growing occupations require the broad perspective, the scientific and technical skills, the attitudes, and the analytical ability that a general education fosters. A course of study for a special program must be planned with and approved by a college faculty adviser. Information on the options and names of faculty advisers prepared to advise in special programs are available in the Counseling and Advising office, 140 Roberts Hall.

**General studies** includes production agriculture as well as technical work in the agricultural and life sciences. Many biotechnology concerns deal with aspects of agriculture, especially plants, crops, and ecosystems in the natural environment. A strong grounding in biological sciences as well as knowledge of the agricultural sciences is

essential in this rapidly growing field. Students should plan basic course work in the major areas of study in the college—animal sciences, plant sciences, environment and technology, agronomic sciences, biological sciences, and social sciences. Advanced courses may be selected in those and other areas of individual interest or career aspiration.

**International Agriculture** provides students with an understanding of the special problems of applying basic knowledge to the processes of agricultural development in low-income countries. The student typically specializes in a particular subject and works with an adviser to plan a program oriented toward international agriculture. The courses in International Agriculture are designed to acquaint students with the socio-economic factors in agricultural development, with the physical and biological nature of tropical crops and animals, and with various world areas for which study programs exist. Competence in a foreign language is required.

In addition to the college distribution requirement of 39 credits, students majoring in International Agriculture must take a minimum of 30 credits. A minimum of 7 credits in International Agriculture and 8 credits (or equivalent competence) in a modern foreign language are required. The other courses recommended are drawn from a wide range of disciplines. The objective is to acquaint students with the many facets of agricultural development in low-income countries. Students are encouraged to take additional specialized courses in one of the other program areas of the college.

### ACADEMIC HONORS

The college encourages high academic achievement and recognizes outstanding students in several ways:

**Dean's List.** Each semester, students are recognized for academic excellence by inclusion in the Dean's List. The criteria are subject to change from semester to semester, and can be obtained from the College Registrar's office in 140 Roberts Hall.

**Bachelor of Science with Distinction.** Students who rank in the top 10 percent of the college's graduates on the basis of the GPA for the last 60 credits completed at Cornell will be graduated with distinction.

**Bachelor of Science with Honors.** Students will graduate with a bachelor of science degree with honors when, in addition to having completed all the graduation requirements, they have satisfactorily completed the honors program in their area of interest and have been recommended for the degree by the honors committee of that area. Special requirements are given in the section on the Honors Program.

**Ho-Nun-De-Kah**, founded in 1929, is the undergraduate honor society of the College of Agriculture and Life Sciences. Members are recruited from the top 20 percent of the senior class and top 10 percent of the junior class. In keeping with the ideals of encouraging scholarship, leadership, and citizenship, members provide free tutoring and a variety of service activities to both the college and the community.

**Gamma Sigma Delta** is an honor society of the faculty in the Colleges of Agriculture and Life Sciences, Human Ecology, and Veterinary Medicine. The common bond is promotion of excellence in work related to the quality of our environment and life based on "agriculture and the related sciences." The Cornell Chapter recognizes the academic achievements of students, faculty, and alumni of those colleges with nominations for membership and with special awards. To be eligible, seniors must be in the upper 15 percent of their major. Five juniors with the highest grade point average in the college are also nominated.

**Phi Kappa Phi** is an honor society that recognizes outstanding scholarship in all academic disciplines. Members are nominated from among seniors, graduate students, and faculty. Seniors must be in the top 10 percent of their class, and juniors in the top 5 percent of their class to be eligible.

**Sigma Xi** is an honor society that recognizes outstanding achievements in research. It was founded at Cornell University in 1886. Its membership is selected mostly from graduate students, faculty, and alumni who have made "noteworthy achievement as an original investigator in a field of pure or applied science." Seniors who have demonstrated research aptitude with publishable independent investigations are also eligible for associate membership.

### DESCRIPTION OF COURSES

Undergraduate and graduate courses in the college are offered through the sixteen academic departments and units and also through the Divisions of Biological Sciences and Nutritional Sciences.

Descriptions of courses, both undergraduate and graduate, are given by department, arranged in alphabetical order.

Graduate study is organized under graduate fields, which generally coincide with the departments. Graduate degree requirements are described in the Announcement of the Graduate School. Courses for graduate students are described in the section on the academic department that offers them.

### NONDEPARTMENTAL COURSES

#### ALS 400 Internship

Fall, spring, or summer. 6 credits maximum. Not open to students who have earned internship credits elsewhere or in previous terms. S-U grades only. Students may register only for internships in the New York State Assembly Intern Program, the New York State Senate Session Assistant's Program, and the Albany Semester Program. A learning contract is negotiated between the student and the faculty supervisor(s), stating conditions of the work assignment, supervision, and reporting. Participation is required in any structured learning activities associated with the internship.

**ALS 500 Politics and Policy: Theory, Research, and Practice (also HSS 404 and GOVT 500)**

Students in the College of Agriculture and Life Sciences must register for ALS 500. S. Jackson and staff.

This course, taught in Washington, D.C., forms the core of the public policy option of the Cornell-in-Washington program. The central course objective is to provide students with the instruction and guidance necessary to analyze and evaluate their own chosen issue in public policy. Toward that end, the course has three components: (1) weekly lectures providing background on the structures and processes of national politics and policy as well as training in research methodology; (2) student externships; and (3) individual research papers or projects. All three components interrelate to provide students with a strategy and framework for integrating classroom-based learning, field experience, and individual research. Applications are made through the Cornell-in-Washington office, 471 Hollister Hall.

**ALS 661 Environmental Policy (also Biology and Society 461 and BIOES 661)**

Fall and spring. 3 credits each term. (Students must register for 6 credits each term since an "R" grade is given at the end of the fall term.) Limited to 12 students. Prerequisite: permission of instructor. Sem R 2:30-4:30 p.m. D. Pimentel.

This course uses an interdisciplinary approach to focus on complex environmental and policy issues. Ten to twelve students, representing several disciplines, investigate significant environmental problems. The research team spends two semesters preparing a scientific report for publication in Science or BioScience.

## AGRICULTURAL AND BIOLOGICAL ENGINEERING

M. F. Walter, chair; B. A. Ahner, L. D. Albright, D. J. Aneshansley, J. A. Bartsch, S. G. Capps, T. J. Cook, J. R. Cooke, A. K. Datta, R. C. Derksen, K. G. Gebremedhin, W. W. Gunkel, D. A. Haith, P. E. Hillman, J. B. Hunter, L. H. Irwin, W. J. Jewell, C. D. Montemagno, J.-Y. Parlange, R. E. Pitt, T. S. Steenhuis, M. B. Timmons, L. P. Walker

**Note:** Class meeting times are accurate at the time of publication. If changes are necessary, the department will provide new information as soon as possible.

**ABEN 102 Introduction to Microcomputer Applications**

Fall. 3 credits. S-U grades optional. Each lab section limited to 14 students. All students, including those pre-enrolled, must attend the first lecture to guarantee admittance to a laboratory section. Lec, T R 12:20-1:10; lab M 1:25-4:25 or 7:30-10:30 p.m. or T 1:25-4:25 or W 1:25-4:25 or 7:30-10:30 p.m., or R 1:25-4:25 p.m. Fee, \$15. 1 evening prelim. P. E. Hillman.

Introduction to application packages on microcomputers. Laboratories provide hands-on experience with word processing, spreadsheets, database management, and presentation graphics. Although the Macintosh computer is used in the laboratory, matching versions of the software are available on PC computers. These packages

and others such as desktop publishing, multimedia, computer-aided design (CAD), Internet, and World Wide Web browsers are discussed and demonstrated in the lectures, as well as computer hardware and Windows.

**ABEN 104 Introduction to Programming using Pascal plus C++ or FORTRAN**

Spring. 4 credits. S-U grades optional. Each lab section limited to 22 students. Lecs, T R 11:15-12:05; lab T 12:20-2:15 (Pascal and FORTRAN) or W 12:20-2:15 (Pascal and C++). Fee, \$15. 2 evening prelims. P. E. Hillman.

An introductory course in computer programming with an emphasis on handling data and algorithm development. Problem sets are on topics of general interest. The first two-thirds of the course utilizes Pascal to introduce students to programming concepts and style. For the last third of the course, students can choose between a gentle introduction to C++ or an introduction to FORTRAN 90. Students are expected to spend 5 to 8 hours outside their scheduled laboratory periods to complete problem sets. No prior knowledge of computers or computer language is necessary.

**ABEN 110 Introduction to Metal Fabrication Techniques**

Spring. 2 credits. Each lab limited to 18 students. Lec, R 9:05; labs M T or R 1:25-4:25, or M T 7-10. T. J. Cook.

Emphasis on selection of proper materials and techniques to accomplish a variety of metal fabrication and maintenance projects. To include both hand and machine tools, fasteners, strengths of materials, classification and identification of metals, soldering, brazing, forging, pipe fitting, sheet metal work, controlling distortion, oxy-acetylene cutting, and arc welding.

**ABEN 120/121 Science of Earth Systems Colloquium (also Soli, Crop and Atmospheric Sciences 101/102 and Geology 123/124)**

120, Fall; 121, Spring. 2 credits. S-U grades only. ABEN 120 is not a prerequisite for ABEN 121. J.-Y. Parlange, K. H. Cook, et al.

Weekly one-hour seminars followed by one-hour discussion of current topics in the study of the earth systems. Introduces the student to scientific issues relating to understanding our planet and managing the environment.

**ABEN 132 Introduction to Wood Construction**

Fall. 2 credits. Each lab limited to 15 students. Lec, T 9:05; labs, T W or R 1:25-4:25, W 7-10. T. J. Cook.

Principles and practice of wood construction. To include site selection and preparation, drainage, water and septic development, footers and foundations, material properties, framing and roofing, comparison of alternatives to wood construction, use of hand and power tools, wood joining methods, fasteners, concrete work, and block construction. Each student will plan and construct an approved carpentry project.

**ABEN 151 Introduction to Computing**

Fall. 4 credits. Prerequisite Math 191 or equivalent (co-registration permissible). Lecs, T R 11:15-12:05; labs, T 2:30-4:25, 12:20-2:15, W 2:30-4:25, R 2:30-4:25, 12:20-2:15; sec, M 7:30-8:20 p.m., 8:30-9:20 p.m., W 7:30-8:20 p.m., W 8:30-9:20 PM, 9:30-10:20 p.m.. Each lab and

recitation section limited to 22 students.

D. J. Aneshansley.

An introduction to computer programming and concepts of problem analysis, algorithm development, and data structure in an engineering context. A structured programming language is used, implemented on interactive personal computers, and applied to problems of interest in agricultural and biological engineering. No previous programming experience is assumed.

**ABEN 200 Undergraduate Seminar**

Spring. 1 credit. S-U grades optional. Lec, T 1:25. Staff.

A forum to discuss the curriculum requirements of the academic programs in the agriculture and biological engineering department and the contemporary and future role of agricultural and biological engineering in society. A required course for freshmen majors in Agricultural and Biological Engineering academic programs. A series of seminars will be given by practicing engineers, Cornell faculty members, alumni of the department, and students. Students are expected to develop personalized, written career plans and select future courses to meet their career goals.

**[ABEN 221 Plane Surveying**

Fall. 3 credits. S-U grades optional. Lecs, M W 12:20; lab M 1:25-4:25. Not offered 1996-97. Staff.

Principles and practice of measurement of distance, elevation, and direction. Use and care of equipment is stressed during field problems related to mapping, engineering design, and construction. Other topics include surveying specifications, error analysis, and standards of accuracy.]

**ABEN 250 Engineering Applications in Biological Systems**

Fall. 3 credits. Prerequisite: enrollment in an engineering curriculum. Recommended for the sophomore year. Lec, M W F 12:20. L. P. Walker.

Case studies of engineering problems in agricultural and biological systems, including animal and crop production, environmental problems, energy, biomedicine, and food engineering. Emphasis is on the application of mathematics, physics, and the engineering sciences to energy and mass balances in biological systems.

**ABEN 301 Introduction to Energy Systems**

Spring. 3 credits. Prerequisite: college physics. Lec, T R 8:40-9:55. M. B. Timmons.

Introduction to energy systems with emphasis on quantifying costs and alternative systems for conversion of environmental inputs into useful forms of energy. Course will cover solar energy, small-scale hydropower, wind, bio-conversion processes, house energy balances, energy crops, and the public policy implications of alternatives. Use of spread sheets will be extensive.

**ABEN 305 Principles of Navigation (also Nav S 301)**

Fall. 4 credits. Four classes each week (lecture-recitation-project work). Lecs, M W F 8:00-8:50; lab, R 8:00 or 9:05. W. W. Gunkel.

An introduction to the fundamentals of marine navigation emphasizing piloting and celestial navigation procedures. The course covers coordinate systems, chart projections,



navigational aids, instruments, compass observations, time, star identification, use of the nautical almanac, tides and currents. Electronic navigation systems are also *briefly* discussed.

**ABEN 310 Advanced Metal Fabrication Techniques**

Spring. 1 credit (2-credit option available).

Prerequisite: ABEN 110 or permission of instructor. Lab, F 1:25-4:30. T. J. Cook.

Principles and practices extending beyond the scope of ABEN 110. To include out-of-position, high carbon steel and cast iron welding. Soldering and brazing of aluminum, hard surfacing, both tungsten (TIG) and metallic (MIG) inert gas welding, plasma-arc and oxy cutting of metals. Planning, development, and fabrication of a metal construction project for the 2 credit option.

**ABEN 331 Environmental Control for Agricultural Production Systems**

Fall. 3 credits. Lecs, M W F 12:20-1:10.

K. G. Gebremedhin.

A study of indoor environmental requirements of plants and animals; design and control of indoor environment of livestock (dairy, beef, and swine) and poultry facilities. Topics include psychrometric processes, energy balances, ventilation design (mechanical and natural), and heat flow. Other topics may include functional layout and design, waste management, economic analysis, and linear programming of agricultural production systems. The course is designed for juniors and seniors in the ABEN Technology Programs, Animal Science, General Studies and General Agriculture students.

**ABEN 350 Biological and Environmental Transport Processes**

Fall. 3 credits. Prerequisites: MATH 294 and fluid mechanics (co-registration permissible). Lecs, M W F 11:15-12:05; disc, W 2:30. A. K. Datta.

Integration of heat and mass transfer in the context of biological and environmental systems. Emphasis is on physical understanding of transport processes and simple reaction rates with application examples from plant and animal biology, the environment (soil/water/air), and industrial processing of food and biomaterials.

**ABEN 367 Introduction to Biological Engineering**

Spring. 3 credits. Prerequisites: one year each calculus and introductory biology; minimum one term each college chemistry and physics. Not open to freshmen. S-U grades optional. Lecs, T R 10:10; lab R or F 1:25-4:25. J. B. Hunter.

Explores the use of engineering principles to solve biological problems in the context of laboratory experiments. Topics may include artificial organs, neuromuscular electrical signals, mass transfer in fermentation, enzyme kinetics, mechanics of plant or animal tissue, and DNA transfer. Many topics relate to ongoing research at Cornell. Appropriate for engineering and life science students. Field trips, demonstrations, and readings in current scientific literature.

**ABEN 371 Hydrology and the Environment (also Soil, Crop, and Atmospheric Sciences 371 and Geology 204)**

Spring. 3 credits. Prerequisite: one course in calculus. 2 lecs, 1 lab. Lecs, T R 9:05; lab, F 2:30-4:25. T. S. Steenhuis, P. C. Baveye, J. Y. Parlange, M. F. Walter, L. Cathles.

Introduction to hydrology: the hydrologic cycle and the role of water and chemicals in the natural environment. Includes precipitation, infiltration, evapotranspiration, ground water, surface runoff, river meandering, floods, and droughts. Case studies, short field trips, computer programs, and laboratories foster an understanding of concepts and principles of hydrologic processes. This course satisfies the capstone design experience requirement.

**ABEN 385 Mechanics in the Earth and Environmental Sciences**

Spring. 4 credits. S-U option. Lecs, M W F 11:15; sec, W 2:30-4:25. P. Baveye, J.-Y. Parlange, and W. Brutsaert.

The study of the earth and the environment requires an understanding of transport and other physical processes within and at the surface of the earth. This course encourages the students to develop a broad working knowledge of mechanics and its application to the earth and environmental sciences, providing the background necessary to study the professional literature.

**ABEN 396 Fundamentals of Engineering Design**

Spring. 3 credits. Lecs, T R 12:20 sec, T 1:25. S. G. Capps.

Fundamentals of design course for junior-level students. Topics and skills discussed will include time and team management, salesmanship and motivation, design constraints, design problem definition and specification, project scheduling, materials selection, cost analysis, ethics, and design evaluation.

**ABEN 435 Principles of Aquaculture**

Spring. 3 credits. Prerequisite: junior standing and above. Lec, T R 1:25-2:15; lab, R 2:30-4:25. M. B. Timmons.

An in-depth treatment of the principles of aquaculture: fish biology, waste treatment, engineering design, fish health, nutrition, processing, etc. This course is intended to build upon the undergraduate's previous course background and interests. Supervised "hands-on" laboratory experiences. An ABEN 496 capstone design project can also be taken in conjunction with this course.

**ABEN 450 Instrument Design: Signal Processing and Data Acquisition**

Fall. 3 or 4 credits. 3 Prerequisites: Linear Differential Equations, physics or electrical science, computer programming and use of spreadsheets. Lec, W M F 9:05-9:55; lab, M W 2:00-4:25. D. J. Aneshansley.

An introduction to static and dynamic characteristics of electronic sensors, transducers, digital and analog signal conditioning circuits and conversion techniques, data acquisition and instrument control with personal computers are considered. Biological and agricultural examples of instrument problems and designs are used. A capstone design project is an option with this course, see instructor for details. An ABEN 496 capstone design project can also be taken in conjunction with this course.

**ABEN 451 Biomass Conversion Processes for Energy and Chemicals**

Spring. 3 credits. Prerequisites: ABEN 250 and 350, MATH 294, Thermodynamics (co-registration permissible), and CHEM 211. Lecs, M W F 9:05. L. P. Walker.

A variety of physical and biological processes are available for converting plants and other

biomass resources into fuels, industrial chemicals, and foods. The design of these processes is accomplished through fusing concepts from biochemistry, microbiology, and plant biology with the concepts and methods of engineering. There are five major components to this course: plants as biochemical resources, heat and mass transfer, enzyme catalysis, fermentation kinetics, and biological filtration with plants. The last four components are concluded with case studies that demonstrate how the scientific and engineering concepts are used to design a biomass conversion process. This course does **not** satisfy the capstone design experience requirement.

**ABEN 453 Computer-Aided Engineering: Applications to Biomaterials and Food Processing**

Spring. 3 credits. Prerequisite: Computer programming and heat and mass transfer (ABEN 350 or equivalent). Lecs, M W F 11:15; computation disc/lab to be arranged. A. K. Datta.

Design, optimization, and analysis of complex real-life processes using state-of-the-art physics-based computational software as powerful tools that are easy to use. Industrial biological and food processing applications of heat and mass transfer are covered in topics such as heat sterilization, freezing, and dehydration. Computational topics introduce finite-difference and finite-element methods, convergence, stability, accuracy, pre-and post-processing, and pitfalls of using computational software. Term project encourages students to develop own ideas, including work related to research projects or other courses not involving such computation. This course satisfies the capstone design experience requirement.

**ABEN 454 Physiological Engineering**

Fall. 3 credits. Prerequisites: Introductory biology, computer programming. Corequisite: fluid mechanics. Lecs, T R 12:20-1:10; lab T R 1:25-4:25. R. E. Pitt.

Engineering analysis and design in the physiology of animals and humans. Use of engineering principles to study how animals work in nature and to intervene in physiological functions. The two major engineering themes are: frequency analysis as applied to neural conduction, sound processing, vision, and image processing; and systematics as applied to cardiovascular and respiratory systems, bioenergetics, and bird flight. Laboratories involve experiments, computing applications, field trips, and guest lectures. An ABEN 496 capstone design project can also be taken in conjunction with this course.

**ABEN 455 Mechanics of Biological Tissues**

Spring. 3 credits. Lecs, T R 9:05-9:55; lab, W 2:30-4:25. S. G. Capps and R. E. Pitt.

Lecture focuses on the importance of material and structural properties of biological tissues. Laboratory exercises are related to procurement, preservation, and storage of biological samples; testing techniques; experimental design; and biomechanical considerations of different material types. This course does **not** satisfy the capstone design experience requirement.

**ABEN 471 Geohydrology (also Civil and Environmental Engineering 431 and Geology 445)**

Fall. 3 credits. Prerequisites: Mathematics 294 and Engr 202. 2 lecs, 1 disc, lecture, field trip. W. Brutsaert, L. M. Cathles, J. Y. Parlange, T. S. Steenhuis.

Intermediate-level study of aquifer geology, groundwater flow, and related design factors. Includes description and properties of natural aquifers, groundwater hydraulics, soil water, and solute transport. This course does **not** satisfy the capstone design experience requirement.

**ABEN 473 Watershed Engineering**

Fall. 3 credits. Prerequisite: Fluid Mechanics or Hydrology. Lecs, T R 9:05; disc, R 1:25-4:30. M. F. Walter.

Engineering principles are applied to the design of soil and water management technologies aimed at solving natural resource problems in the context of watersheds. Emphasis will be placed on rural and countryside engineering and small-scale design for soil erosion control, flood damage control, earthen dams, ponds, moisture conservation, drainage, irrigation, and water supply. This course satisfies the capstone design experience.

**ABEN 474 Drainage and Irrigation Design**

Spring. 3 credits. Prerequisites: Fluid Mechanics or Hydrology. Lecs, M W F 12:20. T. S. Steenhuis and L. D. Geohring.

This course will focus on design of drainage and irrigation systems for agriculture and non-agricultural purposes. The course will also briefly cover design for rural water supply and sanitation systems. Emphasis is placed on problem solving with actual situations used wherever possible. One major design project is required of each student. This course satisfies the capstone design experience requirement.

**ABEN 475 Environmental Systems Analysis**

Fall. 3 credits. Prerequisites: computer programming and one year of calculus. Lecs, M W F 1:25-2:15. D. A. Haith.

Systems analysis and its use in environmental quality management. Emphasis is on modeling of environmental problems, translation of models into efficient computational algorithms, and use of computer simulation and optimization procedures (search techniques, linear programming, dynamic programming, and separable programming) to evaluate management alternatives. Applications include pollution control and resource management problems. This course does **not** satisfy the capstone design experience requirement.

**ABEN 476 Solid Waste Engineering**

Spring. 3 credits. Prerequisites: 1 semester of physics and chemistry. Lecs, M W F 1:25. D. A. Haith.

Planning and design of processes and facilities for management of municipal solid wastes. Source characterization and reduction; collection and transport systems; waste-to-energy combustion; sanitary landfills; composting; recycling and materials recovery facilities; hazardous waste management. Emphasis on quantitative analyses. This course does **not** satisfy the capstone design experience requirement.

**ABEN 477 Treatment and Disposal of Agricultural Wastes**

Fall. 3 credits. Prerequisites: One environmental science course and at least junior-level standing; or permission of instructor. T R 2:30-3:45. W. J. Jewell.

Overview of pollution problems in agriculture, legal restrictions, and technologies used to control pollution. Biological, physical, and chemical processes are applied to solve problems associated with animal wastes, food production, and food and fiber processing. This course does **not** satisfy the capstone design experience requirement.

**ABEN 478 Ecological Engineering**

Spring. 3 credits. Prerequisite: Junior-level environmental quality engineering course or equivalent. Lecs, T R 2:30-3:45. W. J. Jewell.

Natural waste treatment systems are sustainable, driven by solar power, and generate useful and valuable by-products. Constructed wetlands, hydroponic applications of plants, wastewater farming, sludge and industrial residue application to land, soil restoration, bioremediation of toxics, and biofilters for air purification are examples of pollution control systems that depend on natural processes. Pollution control mechanisms in soils and plants are defined and used to design innovative treatment systems for agriculture, municipalities, and industry. This course satisfies the capstone design experience requirement.

**ABEN 481 Design of Wood Structures**

Spring. 3 credits. Prerequisite: ENG 202. Lecs, M W F 10:10. K. G. Gebremedhin.

Two evening prelims. Computer-aided and manual computation procedures of engineering wood structures. Topics include national design codes; estimation of design loads (dead, live, wind, snow, and seismic loads); mechanical properties of materials; designs of beams, columns, trusses, frames, arches, shear walls, horizontal diaphragms of post-frame buildings, connections, and special wood (glue-laminated) structural systems. Engineering judgment and individual responsibility in engineering design are also emphasized. This course satisfies the capstone design experience requirement.

**ABEN 482 Bioenvironmental Engineering**

Spring. 3 credits. Prerequisites: ABEN 250 and 350, or equivalent. Lecs, T R 11:15; lab, W 1:25-4:25. L. D. Albright.

Analysis and design of structures to modify the thermal and aerial environment of animals and plants. Environmental requirements of animals and plants, and the design of buildings to act as buffers between biological systems and climate. Heat flow, air flow, psychrometrics, energy balances, temperature biology, animal and plant models, thermal modeling, mechanical and natural ventilation, solar energy, and weather phenomena. This course satisfies the capstone design experience requirement.

**ABEN 491 Highway Engineering (also Civil and Environmental Engineering 362)**

Fall. 3 credits. Prerequisites: junior standing in engineering, fluid mechanics, and soil mechanics (may be taken concurrently). Lec, F 1:25-4:25; lab, M 1:25-4:25. L. H. Irwin.

An introduction to highway engineering with an emphasis on design. Students will work in

teams to apply the current standards and design criteria used in professional practice to several highway design projects. Topics of discussion include route location and design, traffic engineering, economic analysis, human factors and public safety, hydrology and drainage design, highway materials, pavement design, and maintenance. This course satisfies the capstone design experience requirement.

**ABEN 494 Special Topics in Agricultural and Biological Engineering**

Fall or spring. 4 credits maximum. S-U grades optional. Hours to be arranged. Staff.

The department teaches "trial" courses under this number. Offerings vary by semester and will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

**ABEN 496 Senior Design in Agricultural and Biological Engineering**

Fall and spring. 1-3 credits. Prerequisite: ABEN 396 or co-registration, and senior standing in ABEN engineering program or permission of instructor. Note: Completing an independent study form is required to register. Hours to be arranged. Staff.

Involves capstone design experience, including a team project, incorporating analysis, design, evaluation, synthesis, and a written report of the end-product. This course may be taken in conjunction with an approved ABEN course (for an approved ABEN course, see ABEN Undergraduate Program publication).

**ABEN 497 Individual Study in Agricultural and Biological Engineering**

Fall and spring. 1-4 credits. S-U option. Prerequisite: written permission of instructor and adequate ability and training for the work proposed. Normally reserved for seniors in upper two-fifths of their class. Students must register with an independent study form (available in 140 Roberts Hall). Hours to be arranged. Staff.

Special work in any area of agricultural and biological engineering on problems under investigation by the department or of special interest to the student, provided, in the latter case, that adequate facilities can be obtained.

**ABEN 498 Undergraduate Teaching**

Fall and spring. 1-4 credits. Prerequisite: written permission of instructor. Students must register with an independent study form (available in 140 Roberts Hall). Hours to be arranged. Staff.

The student assists in teaching an agricultural and biological engineering course appropriate to his/her previous training. The student meets with a discussion or laboratory section, prepares course materials, grades assignments, and regularly discusses objectives and techniques with the faculty member in charge of the course.

**ABEN 499 Undergraduate Research**

Fall and spring. 1-3 credits. Prerequisites: normally reserved for seniors in upper two-fifths of their class. Adequate training for work proposed. Written permission of instructor. Students must register with an independent study form (available in 140 Roberts Hall). Hours to be arranged. Staff.

Research in any area of agricultural or biological engineering on problems under investigation by the department or of special interest to the student, provided that adequate facilities can be obtained. The student must review pertinent literature, prepare a project outline, carry out an approved plan, and submit a formal final report.

**ABEN 501-502 M.P.S. Project**

Fall and spring. 1-6 credits. Required of each M.P.S. candidate in the field. Hours to be arranged. ABEN graduate faculty. A comprehensive project emphasizing the application of agricultural technology to the solution of a real problem.

**ABEN 551-552 Agricultural and Biological Engineering Design Project**

Fall and spring. 3-6 credits. Prerequisite: admission to the M.Eng. (Agr.) degree program. Hours to be arranged. ABEN graduate faculty. Comprehensive design projects dealing with existing engineering problems in the field. Emphasis is on the formulation of alternative design proposals that include consideration of economics, nontechnical factors, engineering analysis, and complete design for the best design solution. Projects are supervised by faculty members on an individual basis. However, there is a formal orientation during the first four weeks of the semester. A formal report and public presentation of the results of the design project are required for completion of the course(s). A minimum of 3 to a maximum of 12 credits of 551-552 is required for the Master of Engineering degree. Students should register for 551 their first semester and complete any additional design project credits with 552. If more than 6 design project credits are desired in one semester, both 551 and 552 may be taken.

**[ABEN 652 Instrumentation: Sensors and Transducers**

Spring. 3 credits. Prerequisites: Linear differential equations, introductory chemistry and introductory physics, or permission of the instructor. Not offered 1996-97. D. J. Aneshanley. Application of instrumentation concepts and systems to the measurement of environmental, biological, and agricultural phenomena. Construction and characterization of electronic sensors and transducers will be emphasized. Image processing techniques will be introduced. A final project is required.]

**ABEN 655 Thermodynamics and Its Applications**

Spring. 3 credits. Prerequisite: Mathematics 293 or equivalent. Lects, M W F 12:20. J. Y. Parlange. Thermodynamics and its applications to problems in engineering and agriculture. Topics include basic concepts (equilibrium, entropy, processes, systems, potentials, stability, phase transitions) and applications (soil and water processes, dilute solutions, electromagnetism, surface phenomena, heat and mass transport, structure of organizations).

**ABEN 671 Analysis of the Flow of Water and Chemicals in Soils**

Fall. 3 credits. Prerequisites: four calculus courses and fluid mechanics. Lec, R 3:35-4:50 (first meeting—TBA after that). J. Y. Parlange.

The course encompasses the full range from simple to complex methods to describe the chemical and water flows on the surface, in the vadose zone, and through the aquifer. Current analytical, semi-analytical, and computer-based techniques are discussed. Both homogeneous and heterogeneous soils are analyzed. Offered alternately with Civil and Environmental Engineering 633—a complementary, but not identical, course.

**[ABEN 672 Drainage**

Spring. 4 credits. Prerequisites: ABEN 471 and two calculus courses. S-U grades optional. Offered alternate years. Not offered 1996-97. Lects, M W F 12:20; lab, T 1:25-4:25. T. S. Steenhuis. Theory of water and solute flow in aquifers, hillslopes, and the vadose zone as it relates to artificial drainage is discussed. Drainage design as it relates to agricultural land, landfills, and land application sites will be critically reviewed. The importance of preferential flow and matrix flow on water quality of drainage waters is examined. Laboratories are used for hands-on experience with measuring soil parameters and for actual drainage design. This course satisfies the capstone design experience requirement.]

**ABEN 677 Treatment and Disposal of Agricultural Wastes**

Fall. 3 credits. Prerequisite: permission of instructor. Lects, T R 2:30-3:45. W. J. Jewell. Emphasis is on the causes of agricultural waste problems and the application of fundamentals of treatment and control methods to minimize related pollution. Fundamentals of biological, physical, and chemical pollution control methods are used in design problems with animal wastes, food production, and food and fiber processing. A semester-long design project is required. This course satisfies the capstone design experience requirement.

**ABEN 678 Nonpoint Source Models**

Spring. 3 credits. Prerequisites: computer programming and calculus. Lects, M W F 2:30. D. A. Haith. Development and programming of simulation models for management of water pollution from runoff and percolation. Emphasis is on prediction of water and chemical inputs to surface waters and groundwater. Applications include urban and rural runoff, lake eutrophication, groundwater waste loadings from land disposal sites, pesticides and nutrients in agricultural drainage, irrigation return flows, and watershed stream flow and sediment yield.

**ABEN 685 Biological Engineering Analysis**

Spring. 4 credits. Prerequisite: T&AM 310 or permission of instructor. Lects, M W F 11:15. J. R. Cooke. Engineering problem-solving strategies and techniques are explored. Students solve several representative engineering problems that inherently involve biological properties. Emphasis is on formulation and solution of mathematical models and the interpretation of results. The student's knowledge of fundamental principles is used extensively.

**ABEN 692 Pavement Engineering (also Civil and Environmental Engineering 643)**

Spring. 4 credits. Limited to engineering seniors and graduate students. Prerequisite: one introductory course in soil mechanics or highway engineering. Lec, M F 2:30-4:25. L. H. Irwin. Application of geotechnical engineering principles to the selection of materials and the design of highway and airfield pavements, computer-based methods for pavement design, structural evaluation of pavements, and pavement systems management. Topics of discussion will include bituminous mixture design; base courses; soil stabilization methods; seal-coat design; design of flexible and rigid pavements; pavement design for frost conditions; and pavement evaluation using nondestructive test methods. Laboratory will provide a case study of pavement systems management.

**ABEN 694 Graduate Special Topics in Agricultural and Biological Engineering**

Fall or spring. 4 credits maximum. S-U grades optional. Hours to be arranged. ABEN graduate faculty. The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

**ABEN 697 Graduate Individual Study in Agricultural and Biological Engineering**

Fall or spring. 1-6 credits. Prerequisite: permission of instructor. S-U grades optional. Hours to be arranged. ABEN graduate faculty. Topics are arranged by the staff at the beginning of the term.

**ABEN 700 General Seminar**

Fall. 1 credit. S-U grades only. M (time to be announced). Staff. Presentation and discussion of research and special developments in agricultural and biological engineering and related fields.

**ABEN 750 Orientation for Research**

Fall. 1 credit. Limited to newly joining graduate students. S-U grades only. Lects, first 7 weeks, R 3:35-4:25; remainder to be arranged. J. A. Bartsch. An introduction to departmental research policy, programs, methodology, resources, and degree candidates' responsibilities and opportunities.

**ABEN 754 Sociotechnical Aspects of Watershed Development (also ARME 754 and Government 644)**

Spring. 2-3 credits. S-U grades optional. T. Steenhuis, M. Walter, N. Uphoff and R. Barker. Examines watershed development and its relation to agriculture, irrigation and other activities within its boundaries. Emphasis on social, technical and economic processes within watersheds, including political and administrative aspects. Provides an opportunity to examine systematically the interaction of various aspects of watershed management and design in developing countries.

**ABEN 771 Soil and Water Engineering Seminar**

Fall and spring. 1-3 credits. Prerequisite: graduate status or permission of instructor. S-U grades optional. Hours to be arranged. T. S. Steenhuis. J.-Y. Parlange and M. F. Walter.

Study and discussion of research or design procedures related to selected topics in irrigation, drainage, erosion control, hydrology, and water quality.

**ABEN 775 Agricultural Waste Management Seminar**

Spring. 1 credit. Limited to graduate students. Prerequisite: permission of instructor. S-U grades only. Hours to be arranged. Staff.

Management of agricultural wastes, with emphasis on physical, chemical, biological, and economic factors affecting waste production, treatment and handling, utilization, and disposal.

**ABEN 781 Structures and Related Topics Seminar**

Spring. 1 credit. Prerequisite: graduate status or permission of instructor. S-U grades only. Hours to be arranged. Staff.

Advanced analysis and design of production systems with emphasis on structural and environmental requirements, biological responses, and economic considerations. Hours to be arranged.

**ABEN 785 Biological Engineering Seminar**

Spring. 1 credit. Prerequisite: graduate status or permission of instructor. S-U grades only. Hours to be arranged. J. R. Cooke.

The interactions of engineering and biology, especially the environmental aspects of plant, animal, and human physiology, are examined in order to improve communication between engineers and biologists.

**ABEN 800 Master's-level Thesis Research**

Fall and spring. 1-15 credits. Prerequisite: permission of adviser. S-U grades. ABEN graduate faculty.

**ABEN 900 Graduate-level Thesis Research**

Fall and spring. 1-15 credits. Prerequisite: permission of adviser. S-U grades. ABEN graduate faculty. Variable credit for Ph.D. research before the "A" exam is passed.

**ABEN 901 Doctoral-level Thesis Research**

Fall and spring. 1-15 credits. Prerequisite: passing of Admission Candidacy Exam and permission of adviser. S-U grades. ABEN graduate faculty.

**AGRICULTURAL, RESOURCE, AND MANAGERIAL ECONOMICS**

A. M. Novakovic, chair; D. J. Allee, B. L. Anderson, R. D. Aplin, N. L. Bills, R. N. Boisvert, J. R. Brake, L. D. Chapman, R. D. Christy, G. J. Conneman, J. M. Conrad, H. de Gorter, E. E. Figueroa, G. A. German, D. A. Grossman, M. J. Hubbert, H. M. Kaiser, R. J. Kalter, W. A. Knoblauch, S. C. Kyle, E. L. LaDue, D. R. Lee, W. H. Lesser, E. W. McLaughlin, R. A. Milligan, T. D. Mount, G. L. Poe, T. T. Poleman, J. E. Pratt, C. Ranney, W. D. Schulze, D. Streeter, L. W. Tauer, W. G. Tomek, C. van Es, G. B. White, L. S. Willett

**Courses by Subject**

Farm management, finance, and production economics: 302, 402, 403, 404, 405, 406, 605, 608, 708

Statistics, quantitative methods, and price analysis: 310, 313, 410, 411, 412, 415, 710, 711, 712, 713, 714, 717

Business management, law, and accounting: 220, 221, 320, 321, 323, 324, 325, 422, 424, 425, 426, 428

Public policy: 430, 431, 432, 630, 730, 731

Marketing and food distribution: 240, 340, 342, 346, 347, 443, 446, 447, 448, 449, 640, 641, 740, 741

Environmental and resource economics: 250, 450, 451, 651, 652, 750, 751, 754

Economics of development: 464, 660, 665, 666, 763

General, contemporary issues, research, and other: 100, 380, 494, 497, 498, 499, 694, 698, 699, 700

**Note: Class meeting times are accurate at the time of publication. If changes are necessary, the department will provide new information as soon as possible.**

**ARME 100 Introduction to Global Economic Issues**

Fall. 3 credits. Lab fees \$35. Lects, M W 11:15-12:05; labs to be arranged. W. D. Schulze.

The course begins with a survey of economic principles and then applies economic analysis to global issues such as: economic growth and the short and long term availability of natural resources; agriculture and population growth; business management, international trade, and global markets; and issues of global environmental management.

**ARME 220 Introduction to Business Management**

Spring. 3 credits. Lects, M W F 10:10-11 or 11:15-12:05; disc, M 2:30-4:25 (2 secs) or 7:30-9:25 p.m. (2 secs); T 8-9:55, or 2:30-4:25; W 10:10-12:05, 12:20-2:15, 2:30-4:25 (2 secs), or 7:30-9:25 p.m. (2 secs); R 8-9:55 or 2:30-4:25. In weeks when discs are held there will be no W lecture. 2 evening prelims. Staff.

An overview of management and business. Provides exposure to key management functions, a firm's internal and external environments, business ethics, forms of business ownership, some key concepts and tools in human resource management, financial management and marketing and important current issues such as quality, global competition, and corporate governance. Several guest executives.

**ARME 221 Financial Accounting**

Spring. 3 credits. Not open to freshmen. Lects, M F 11:15-12:05 or 12:20-1:10; sec, T 10:10-12:05 (2 secs), 12:20-2:15, or 2:30-4:25; W 10:10-12:05 (2 secs), 12:20-2:15 (2 secs), 2:30-4:25 (2 secs), or 7-9 p.m. (2 secs); or R 10:10-12:05, 12:20-2:15, or 2:30-4:25. 2 evening prelims and a comprehensive final, weekly homework assignments, and 2 written case studies. M. J. Hubbert.

A comprehensive introduction to financial accounting concepts and techniques, intended to provide a basic understanding of the accounting cycle, elements of financial statements, underlying theory of GAAP, and statements interpretation. Elements examined include inventory, depreciation, internal control of assets, time value of money, notes, stocks, bonds, and the statement of cash flows. Limited use of a financial data base of publicly held companies; introduction to financial information on the World Wide Web.

**ARME 240 Marketing**

Fall. 3 credits. Lects, M W F 10:10-11; discs, M 2:30-3:20; T 12:20-1:10 (2 secs), 1:25-2:15 (2 secs), 2:30-3:20, or 3:35-4:25; W 12:20-1:10 (2 secs), 1:25-2:15 (2 secs), 2:30-3:20, or 3:35-4:25; R 12:20-1:10 (2 secs), 1:25-2:15 (2 secs), 2:30-3:20, or 3:35-4:25; or F 10:10-11:00. 5 discussion sections are held during the semester. In weeks discussions are held, there will be no F lecture. E. W. McLaughlin.

This course provides a broad introduction to the fundamentals of marketing. We will explore the components of an organization's strategic marketing program, including how to price, promote, and distribute goods, services, ideas, people, and places. We will examine specifically the central role played by changing consumers; our primary emphasis will be placed on consumer goods industries. Although examples will frequently be drawn from the food and agricultural system, the principles and concepts from this course will apply equally well to the marketing of goods and services in all sectors of the economy. Case studies, industry guest lectures, and current marketing applications from various companies will be presented and analyzed.

**ARME 250 Environmental Economics**

Spring. 3 credits. Lects, T R 2:30-3:45. D. Chapman.

Concepts and methods used in the public and private analysis of environmental resources. Subjects include valuation and benefit-cost analysis. Major current economic problems such as economic incentives in environmental policy, endangered species protection, forestry, energy use, world petroleum resources, and global warming. The growing world trade in resource-intensive manufactured products and the impact on income, employment, and pollution. Comparative resource use and environmental protection in industrialized and developing countries.

**ARME 302 Farm Business Management**

Fall. 4 credits. Not open to freshmen. This course is a prerequisite for ARME 402 and 405. Lects, M W F 9:05-9:55; sec, W or R 1:25-4:25. On days farms are visited, the section period is 1:25-6:00. W. A. Knoblauch.

An intensive study of planning, directing, organizing, and controlling a farm business, with emphasis on the tools of managerial analysis and decision making. Topics include financial statements, business analysis,



budgeting, and acquisition, organization, and management of capital, labor, land, buildings and machinery.

**ARME 310 Introductory Statistics**

Fall or spring. 4 credits. Prerequisite: EDUC 115 or equivalent level of algebra. Lec, M W F 1:25-2:15; sec T 10:10-12:05, 12:20-2:15, or 2:30-4:25 (2 secs); W 11:15-1:10 or 2:30-4:25 (2 secs); or R 12:20-2:15 or 2:30-4:25 (2 secs). 3 evening prelims. C. van Es.

An introduction to statistical methods. Topics to be covered include the descriptive analysis of data, probability concepts and distributions, estimation and hypothesis testing, regression, and correlation analysis. Applications from business, economics, and the biological sciences are used to illustrate the methods covered in the course.

**ARME 313 Information Systems and Decision Models**

Fall. 3 credits. Limited to juniors and seniors. Prerequisites: ABEN 102 or equivalent, ECON 101 or equivalent, and ARME 310. Lec, M W 10:10-11; lab, M 12:20-2:15, 4:35-6:30, or 7:30-9:25 p.m.; T 12:20-2:15, 2:30-4:25 or 4:35-6:30. Staff.

The focus of the course is on information systems and the quantitative approaches used in business decision making. The computer models presented enable the student to appreciate information systems, identify problems that can be analyzed with business decision making techniques, examine problems using analytical techniques, and gain a perspective for critiquing the decision making process.

**ARME 320 Business Law I**

Fall. 3 credits. Limited to juniors, seniors, and graduate students. Lec, M W F 9:05-9:55. 1 evening prelim. D. A. Grossman. Consideration is given chiefly to legal problems of particular interest to persons who expect to engage in business. Emphasis is on the law pertaining to contracts, sales, agency, property, and the landlord-tenant relationship.

**ARME 321 Business Law II**

Spring. 3 credits. Limited to juniors, seniors, and graduate students. Prerequisite: a course in business law. Lec, T R 8:30-9:55. D. A. Grossman.

The first portion of this course examines legal issues in the formation and operation of business enterprises, particularly partnerships, corporations, and limited liability companies. The second portion of the course will review selected topics in business law, like employment discrimination, secured transactions, product liability, unfair competition, and computer law.

**ARME 323 Managerial Accounting**

Fall. 3 credits. Prerequisite: ARME 221 or equivalent. Lec, M W 12:20-1:10; disc, R 10:10-12:05, 12:20-2:15 (2 secs), or 2:30-4:25 (2 secs); or F 10:10-12:05 or 12:20-2:15 (2 secs). 2 evening prelims, a third exam, weekly homework, one written case study, and one project on an electronic spreadsheet. M. J. Hubbert.

An introduction to cost accounting that emphasizes the application of accounting concepts to managerial control and decision making. Major topics include product costing, standard costing, cost behavior, cost allocation, budgeting, inventory control, variance analysis, measuring divisional performance,

and accounting systems in the manufacturing environment. Limited use of electronic spreadsheets.

**ARME 324 Financial Management**

Spring. 4 credits. Prerequisite: ARME 220 or equivalent. Recommended: ARME 221 and 310 or equivalents. Lec, M W F 9:05-9:55; disc, W 2:30-4:25 or R 9:05-11, 12:20-2:15, or 2:30-4:25, or F 10:10-12:05 or 12:20-2:15. 2 evening prelims. B. L. Anderson.

Focuses on three major questions facing management: how to evaluate capital investment decisions, how to raise the capital to finance the firm, and how to generate sufficient cash flows to meet the firm's cash obligations. Major topics include methods to analyze investment decisions, impact of taxes, techniques for handling risk and uncertainty, effects of inflation, sources and costs of debt and equity, capital structure, leverage, and working capital management. Microcomputers are used for analyzing financial problems. Previous computer experience is preferred, but optional instruction offered.

**ARME 325 Personal Enterprise and Small Business Management**

Spring. 3 credits. Limited to juniors and seniors. Prerequisites: ARME 220 and 221 or permission of instructor. Absolutely no adds or drops after second class meeting. Lec, T R 12:20-1:35, or 2:30-3:45. D. Streeter.

Acquaints students with the challenging role of small business in the global economy. Special emphasis on the problems of planning, starting, and managing a new business, including strategic planning, marketing, financing, and managing growth. Term project, development of a business plan, is done in teams of no fewer than three. Case studies and visiting entrepreneurs illustrate various small business issues.

**[ARME 340 Futures and Options Trading]**

Spring. 3 credits. Prerequisites: ECON 101. Open by application only. S-U grades optional. Not offered 1996-97. Staff.

The focus of the course is on the use of agricultural financial futures and options as marketing and management tools. A primary objective is to understand how companies, financial institutions, and farm businesses can employ hedging strategies to manage risk. Students will participate in a simulated trading exercise in which they will use real-time price and market information and input from industry experts to manage a hedge position.]

**ARME 342 Marketing Management**

Spring. 3 credits. Limited to juniors, seniors, and graduate students. Prerequisites: ARME 240 and ECON 101-102. Lec, M W F 10:10-11; disc, R 12:20-1:10 (2 secs) or 2:30-3:20 (2 secs); F 10:10-11 (2 secs), or 12:20-1:10 (2 secs). In weeks discs are held, there will be no F lecture. R. D. Christy.

Deals with the central link between marketing at the societal level and everyday consumption by the general public. As such, this course emphasizes the management aspects of marketing by considering consumer behavior, strategies in product and brand selection, pricing, promotion, sales forecasting, and channel selection. Identification and generation of economic data necessary for marketing decisions are considered. Public

policy and ethical dimensions of marketing are examined.

**[ARME 346 Dairy Markets and Policy]**

Spring. 3 credits. Limited to juniors and seniors. Prerequisite: ECON 101 or equivalent. Offered alternate years. Not offered spring 1997. Next offered spring 1998. Lec, T R 8:30-9:55. H. M. Kaiser.

A survey of the structural and institutional characteristics of dairy markets and the analysis of policy issues, pricing systems, and government programs, including marketing orders, price supports, and import policies.]

**ARME 347 Marketing Fruits, Vegetables, and Ornamental Products**

Fall. 3 credits. S-U grades optional. A mandatory 2-day field trip. Estimated cost of field trip, \$50. Lec, M W F 12:20-1:10. E. E. Figueroa.

A study of fruits, vegetables, and ornamental product marketing, including seasonal variations. Role of market intermediaries, role of government agencies, and the price discovery process. Discussion and description of horticultural product market orders in the U.S. The emerging importance of interregional and international markets.

**ARME 380 Independent Honors Research in Social Science**

Fall or spring. 1-6 credits. Limited to students who have met the requirements for the honors program. See "Honors Program" in CALS section of this catalog. Provides qualified students an opportunity to conduct original research under supervision. Information available in ARME undergrad program office in Warren Hall.

**ARME 402 Seminar in Farm Business Planning and Managerial Problem Solving**

Fall. 3 credits. 6 half-day field trips. On days field trips are taken, class ends at 5:30. Prerequisite: ARME 302 or equivalent. Lec, T R 12:20-1:10; disc, R 1:25-4:25. G. J. Conneman.

A capstone seminar/workshop designed for seniors who plan to return to the family business or home farm or to take positions in banking, credit, or agribusiness, as well as those who wish to establish entrepreneurial businesses. The objective of the course is to pull together interdisciplinary knowledge and apply it in a problem-solving/critical-thinking management context.

**ARME 403 Farm Management Study Trip**

Spring. 1 credit. Prerequisite: ARME 302. Open by application only. Secs, arranged. W. A. Knoblauch.

A special program to study production and management systems in diverse agricultural regions of the U.S. Includes a trip (usually taken during spring break) to the region being studied. A different region is visited each year. The course meets in advance of the study trip and upon return from trip. A paper, selected by the student, which further explores an aspect of the trip, is a requirement for completing the course.

**ARME 404 Advanced Agricultural Finance Seminar**

Spring. 2 credits. Limited to 16 seniors with extensive course work in farm management and farm finance. Open by application prior to March 1 of the year before the course is offered. W 3:35-5:30. E. L. LaDue.

A special program in agricultural finance, conducted with financial support from the Farm Credit System. Includes two days at Farm Credit Banks of Springfield, one week in Farm Credit Association offices, a field trip to observe FHA financing during fall term, a four-day trip to financial institutions in New York City during intersession, and an actual farm consulting and credit analysis in the spring term.

#### **ARME 405 Farm Finance**

Spring. 4 credits. Prerequisite: ARME 302 or equivalent. Lects, M W F 9:05-9:55; disc, T 1:25-3:20. E. L. LaDue.

The principles and practices used in financing farm businesses, from the perspectives of the farmer and the farm lender. Topics include sources of capital, financing entry into agriculture, financial analysis of a business, capital management, financial statements, credit instruments, loan analysis, financial risk, and leasing.

#### **ARME 406 Farm and Rural Real Estate Appraisal**

Spring, weeks 7-15. 2 credits. Limited to 40 students. Prerequisites: ARME 302 or equivalent and permission of instructor. Lec, R 11:15-12:05; sec R 1:25-5:30. 6 half-day field trips, 1 all-day field trip. G. J. Conneman.

The basic concepts and principles involved in appraisal. Factors governing the price of farms and rural real estate and methods of valuation are studied. Practice in appraising farms and other rural properties.

#### **ARME 410 Business Statistics**

Spring. 3 credits. Prerequisite: ARME 310 or equivalent. Lects, M W F 10:10-11. C. van Es.

This course focuses on four major topics used to analyze data from marketing research, business, and economics. Topics studied are: survey sampling procedures, contingency table analysis, time series and forecasting, and experimental design and ANOVA. The course will involve a research project designed to give experience in collecting and interpreting data.

#### **ARME 411 Introduction to Econometrics**

Spring. 3 credits. Prerequisite: ARME 310 or equivalent. Lects, T R 10:10-11:25. J. E. Pratt.

The course introduces students to basic econometric principles and the use of statistical procedures in empirical studies of economic models. Assumptions, properties, and problems encountered in the use of multiple regression procedures are discussed and simultaneous equation models are introduced. Students are required to specify, estimate, and report the results of an empirical model using econometric methods.

#### **ARME 412 Introduction to Mathematical Programming**

Fall. 3 credits. Primarily for juniors, seniors, and M.S. degree candidates. Prerequisite: ARME 310 or equivalent. Lects, T R 12:20-1:35. J. E. Pratt.

This is a course in applied linear programming. Following a review of linear algebra, the emphasis will be on formulation, specification, and interpretation of solutions to mathematical models of economic problems. Standard LP problems such as work scheduling, blending, resource allocation, capital budgeting, transportation and financial

planning, inventory management, etc., will be studied. Integer and nonlinear programming will be introduced, if time permits.

#### **ARME 415 Price Analysis**

Fall. 3 credits. Prerequisites: ECON 313 or CEH 210 or equivalent, ARME 310 or equivalent. Lects, M W F 9:05-9:55. H. M. Kaiser.

The focus of this course is on the analysis of supply and demand characteristics of commodities with particular attention to agricultural products. Institutional aspects of pricing, temporal and spatial price relationships, price forecasting, and the economic consequences of pricing decisions are included.

#### **ARME 422 Estate Planning**

Fall. 1 credit. Limited to juniors, seniors, and graduate students. S-U grades only. Lects, M 3:35-4:25. D. A. Grossman.

Fourteen sessions on the various aspects of estate-planning techniques. The law and use of trusts, the law of wills, federal and New York State estate and gift taxes, and substitutes for probate procedures are covered.

#### **ARME 424 Business Policy**

Fall. 3 credits. Limited to seniors majoring in business management and marketing. T R 9:05-10:35, 11:15-12:45 or 2:30-4:00. R. D. Aplin.

An integrating course that examines business policy formulation and implementation from the standpoint of the general manager of an organization, focusing on decision making and leadership. The course is built around a series of cases. Several guest executives. Emphasizes improving oral and written communication skills.

#### **ARME 425 Small Business Management Workshop**

Fall. 4 credits. Limited to seniors. Prerequisite: ARME 325 or NBA 300 and permission of instructor. Term project work will amount to approximately \$100 per team. Lects, M W 2:30-4:25. D. Streeter.

Students serve as counselors to small businesses in the central New York area and confront problems facing small personal enterprises. Encourages the application of business principles to an existing business and the witnessing of the results of firm-level decision making. Student teams meet with the business owners and course staff at arranged times during the semester.

#### **ARME 426 Cooperative Management and Strategies**

Spring. 3 credits. Recommended: ARME 220 or equivalent. Estimated cost of field trip, \$50. Lects, M W F 12:20-1:10. 2 day field trip required. B. L. Anderson.

Investigates the unique aspects of cooperative, membership, and not-for-profit organizations. Issues are approached from the point of view of management, the board of directors, and members. Topics include characteristics of various types of business organizations, cooperative principles, legislation, taxation, as well as the unique nature of corporate strategies, management, financing, and marketing in cooperative, membership, and not-for-profit organizations. Primary focus is on operating cooperatives in agriculture although alternative types of cooperative organizations are discussed, such as: credit unions, insurance cooperatives, employee

stock ownership plans, housing cooperatives, flexible manufacturing networks, consumer cooperatives, and membership organizations.

#### **[ARME 428 Technology: Management and Economic Issues**

Spring. 3 credits. Prerequisites: ECON 101-102, or permission of instructor. Limited to juniors and seniors. Not offered 1996-97. Lects, T R 10:10-11:25. R. J. Kalter.

Designed to acquaint students with the role of technology in modern society, business, and education. Emphasis is placed on the context for managerial analysis and decisions with respect to technological adoption. Topics include the historical influence of technology on economic structure and activity, contemporary technological trends, implications for business managers, adoption and diffusion, public acceptance, implications for future structural and spatial organization of economic activity, impediments to technological advancement, and public policy considerations.]

#### **ARME 430 International Trade Policy**

Spring. 3 credits. Prerequisites: ECON 101-102 or equivalents. Lects, T R 12:20-1:35. Optional disc to be arranged. D. R. Lee.

This course examines the economic principles underlying international trade and monetary policy, and the policies, practices, and institutions that influence trade and foreign exchange markets. Applications to current topics in international trade policy, to trade in primary commodities, and to both developed and developing countries are also emphasized.

#### **ARME 431 Food and Agricultural Policies**

Fall. 3 credits. Lects, T R 9:05-9:55; disc, R 11:15-12:05 or 3:35-4:25. H. de Gorter.

The course deals broadly with food and agricultural policies, including price support and storage or reserve policies, agricultural protection, soil conservation programs, the structure of agriculture, domestic food subsidy programs, environmental issues, and food safety. The importance of international trade and agricultural policies in other countries is emphasized.

#### **[ARME 432 Economics of the Public Sector**

Spring. 3 credits. Prerequisite: ECON 313 or CEH 210 or equivalent. Not offered 1996-97. Staff.

The application of economic concepts to the evaluation of the structure and performance of the public sectors of the economy. Emphasis on microeconomic analysis of public finance and public resource allocation. Principal topics: market failure, articulation of public choice and interests, evaluation of public decisions, and current public policy.]

#### **ARME 443 Food-Industry Management**

Fall. 4 credits. Limited to juniors and seniors. Prerequisite: ARME 448 or 342 or permission of instructor. Lects, T R 10:10-11:25; sec T 1:25-2:40. G. A. German.

A case-study approach is used to examine the application of management principles and concepts to marketing and distribution problems of the food industry. Cases covering new product introductions, merchandising strategies, and investment decisions are included. Guest speakers from the food industry present case-study solutions at the Tuesday session.

**ARME 446 Food Marketing Colloquium**

Fall. 1 credit. Limited to juniors and seniors with extensive course work in food industry management and marketing. Permission of the instructors. S-U grades only. R 3:35-5. G. A. German, E. W. McLaughlin, and D. J. Perosio.

ARME 446 and 447 have been developed as a two-semester special seminar that provides the weekly focus for the Food Marketing Fellows Program. The seminar will cover advanced topics in food marketing, many of which will have an important international dimension and will be presented by industry members. A number of field trips will be taken, including an international trip during January intersession and a five-day trip to the Food Marketing Institute Convention in Chicago during the first week in May. Students will prepare research topics on various aspects of the food industry.

**ARME 447 Food Marketing Colloquium**

Spring. 1 credit. Limited to juniors and seniors with extensive course work in food industry management and marketing. Permission of instructors. S-U grades only. R 3:35-5. G. A. German, E. W. McLaughlin, and D. J. Perosio.

ARME 446 and 447 have been developed as a two-semester special seminar that provides the weekly focus for the Food Marketing Fellows Program. The seminar will cover advanced topics in food marketing, many of which will have an important international dimension and will be presented by industry members. A number of field trips will be taken, including an international trip during January intersession and a five-day trip to the Food Marketing Institute Convention in Chicago during the first week in May. Students will prepare research topics on various aspects of the food industry.

**ARME 448 Food Merchandising**

Spring. 3 credits. Limited to juniors and seniors. Prerequisite: ARME 240. Lects, T R 12:20-1:35. G. A. German and D. J. Perosio.

Merchandising principles and practices as they apply to food industry situations. The various elements of merchandising such as buying, pricing, advertising, promotion, display, store layout, profit planning and control, and merchandising strategy are examined in this course. The consequences of food industry trends and initiatives for other industry members, public policymakers, and consumers are considered.

**ARME 449 Global Marketing Strategy**

Fall. 3 credits. Prerequisite: ARME 342. S-U grades optional. T R 1:25-2:40. W. H. Lesser.

This course will examine the marketing environment, opportunities, and challenges in the rapidly changing global marketplace. We will explore what factors are predictive of business success in various national markets and the means by which these factors can be incorporated into firm strategy. The focus of the course will be kept practical and managerial through liberal use of actual case studies.

**ARME 450 Resource Economics**

Fall. 3 credits. Prerequisites: MATH 111 and ECON 313. Lects, M W F 2:30-3:20. J. M. Conrad.

Dynamic models of renewable, nonrenewable, and environmental resources will be constructed to examine market allocation and optimal resource management.

**ARME 451 Environmental Economics and Policy**

Spring. 3 credits. Prerequisite: ECON 313; ARME 250 recommended. S-U grades optional. Lects, M W 2:55-4:10. Staff.

This course applies economic concepts to public decision making about environmental commodities and natural resources. Two economic paradigms of allocating public goods will be explored: the conventional economic approach, with specific emphasis on market failure, externalities, benefit-cost analysis, and the use of non-market valuation techniques; and a property rights/institutional perspective.

**ARME 464 Economics of Agricultural Development**

Spring. 3 credits. Prerequisites: ECON 101-102, or permission of instructor. Lects, T R 12:20-1:35. R. D. Christy.

This course is designed to provide an understanding of the economics of the agricultural sector in low-income countries. In addition, more general issues of economic development beyond the agricultural sector will be covered in order to provide the necessary context for an understanding of rural problems. Among the areas covered are the nature of development and technical change, welfare and income distribution, land reform, food and nutrition policy, food security and food aid, competition with more developed countries and international markets, the effect of U.S. policy on agricultural development, and the role of international institutions. Examples from a wide variety of developing countries will be used to illustrate the basis for economic analysis.

**ARME 494 Undergraduate Special Topics in Agricultural, Resource, and Managerial Economics**

Fall or spring. 4 credits maximum. S-U grades optional. Staff.

The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department.

**ARME 497 Individual Study in Agricultural, Resource, and Managerial Economics**

Fall or spring. Variable credit. S-U grades optional. Students must register with an Independent Study form (available in 140 Roberts Hall). Staff.

To be used for special projects designed by faculty members.

**ARME 498 Supervised Teaching Experience**

Fall or spring. 1-3 credits. Total of 4 credits maximum during undergraduate program. Students must register with an Independent Study form (available in 140 Roberts Hall). Staff.

Designed to give qualified undergraduates experience through actual involvement in planning and teaching courses under the supervision of department faculty. Students are expected to actually teach at least one hour per week for each credit awarded. Students cannot receive both pay and credit for the same hours of preparation and teaching.

**ARME 499 Undergraduate Research**

Fall, spring, or summer. 1-4 credits. Limited to students with grade-point averages of at least 2.7. Prerequisite: written permission of the staff member who will supervise the work and assign the grade. Students must register with an

Independent Study form (available in 140 Roberts Hall). S-U grades optional. Staff. Permits outstanding undergraduates to carry out independent study of suitable problems under appropriate supervision. Students cannot receive both pay and credit for the same hours of work.

**ARME 605 Agricultural Finance and Capital Management**

Fall. 3 credits. Prerequisite: ARME 405 or equivalent. Offered alternate years. Offered fall 1996 and fall 1998; not offered fall 1997. \$25 charge for reading materials; no text. T R 8:40-9:55. E. L. LaDue and L. W. Tauer.

Advanced topics in capital management and financing of agriculture. Special emphasis on current issues. Example topics: farm-sector funds flows, financial risk and decision analysis, agricultural finance policy, financial intermediation and intermediaries, firm growth, inflation, loan evaluation, and selected topics on financing agriculture in developing countries.

**ARME 608 Production Economics**

Fall. 3 credits. Recommended: ECON 313 and MATH 111 or equivalents. Lects, M W F 10:10-11. L. W. Tauer.

The theory of production economics with emphasis on applications to agriculture. Topics include the derivation, estimation, and use of production, cost, profit, demand, and supply functions. Production response over time and under risk is introduced.

**ARME 630 Policy Analysis: Welfare Theory, Agriculture, and Trade**

Spring. 4 credits. Prerequisites: ARME 608 or CE&H 603, ECON 313, or equivalent intermediate micro theory incorporating calculus. Lects, T R 8-9:55. H. de Gorter and staff.

The first half of the course surveys the theory of welfare economics as a foundation for public policy analysis. Major issues addressed include the problem of social welfare measurement, the choice of welfare criteria, and the choice of market or nonmarket allocation. Basic concepts covered include measurement of welfare change, including the compensation principle, consumer and producer surplus, willingness-to-pay measures, externalities, and the general theory of second-best optima. The second half of the course focuses on public policy analysis as applied to domestic agricultural policy and international trade. The domestic policy component examines major U.S. farm commodity programs and related food and macroeconomic policies and analyzes their effects on producers, consumers, and other groups. The international trade component examines the structure of world agricultural trade, analytical concepts of trade policy analysis, and the principal trade policies employed by countries in international markets.

**ARME 640 Analysis of Agricultural Markets**

Fall, weeks 1-7 (ends Oct. 17). 2 credits. Prerequisites: ARME 411 and 415 or equivalents. Lects, T R 2:30-4:25. W. G. Tomek.

This course is about agricultural product markets. Focus is placed on their distinguishing characteristics, criteria for evaluating performance, models of price determination, and selected public-policy issues related to market performance.

**ARME 641 Commodity Futures Markets**

Fall, weeks 8-14 (starts Oct. 22). 2 credits.  
Prerequisites: ARME 411 and 415 or equivalents. Recommended: ARME 640.  
Lecs, T R 2:30-4:25. W. G. Tomek.

This course is primarily about markets for agricultural futures contracts. Emphasis is placed on models of price behavior on cash and futures markets including relationships among prices. These principles provide a foundation for a discussion of hedging, speculation, and public-policy issues.

**ARME 651 Environmental and Resource Economics**

Spring. 4 credits. Limited to graduate students. Lec, T R 10:10-11:25.  
W. D. Schulze.

Applied welfare economics with specific applications to environmental and resource issues. Review of welfare economics, environmental externalities, and common property resources, and a survey of current environmental and natural resource policy. Techniques for measuring benefits and cost—including property value and wage hedonic approaches, travel models and contingent valuation—are covered. Survey/data collection methods are described in detail. Explore innovative market mechanisms for resolving public good, common property, and externality problems. Students will be required to complete a paper describing their own formal economic analysis of a natural resource or environmental problem. ARME 651 is a core course for the Environmental Management concentration/option.

**ARME 652 Land Economics Problems (co-listed with Civil and Environmental Engineering 529)**

Fall or spring. 1 or more credits. Limited to graduate students. Prerequisite: permission of instructor. S-U grades optional. Hours to be arranged.  
D. J. Allee.

Special work on any subject in the field of land and resource economics.

**ARME 660 The World's Food**

Spring. 3 credits. S-U grades optional.  
T R 12:20-1:40. T. T. Poleman.

Designed to introduce first-year graduate students to food economics, the world food situation, and the linkages between food, population, and employment in developing countries. Among the topics considered are the extent of hunger, income and dietary change, control of population growth, and the outlook for feeding an eventual population of 10-12 billion.

**ARME 665 Food and Nutrition Policy (also Nutritional Sciences 685)**

Spring. 3 credits. Prerequisites: Introductory microeconomics and intermediate statistics (i.e. through multiple regression), or permission of instructor. S-U grades optional. Lec, M W 2:30-3:40. D. Sahn and P. Dorosh.

For description, see NS 685.

**ARME 666 Economics of Development**

Spring. 3 credits. Prerequisites: ECON 313 and 314 or permission of instructor. S-U grades optional. Lec, T R 10:10-11:25. S. C. Kyle.

The course is designed as an introduction to the economics of development at the graduate level. The course will be split into two major sections, the first dealing with the micro-economics of households in developing

countries and the second covering macroeconomic strategy and performance. A principal goal will be to illuminate the particular features of low-income countries which are important to economic analysis and policy. Special attention will be given to issues facing countries with important agricultural and resource sectors.

**ARME 694 Graduate Special Topics in Agricultural, Resource, and Managerial Economics**

Fall or spring. 4 credits maximum. S-U grades optional. Staff.

The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department.

**ARME 698 Supervised Graduate Teaching Experience**

Fall or spring. 1-3 credits. Total of 4 credits maximum during graduate program. Students must register with an Independent Study form (available in 140 Roberts Hall). Open only to graduate students. Undergraduates should enroll in ARME 498. S-U grades optional. Prerequisite: permission of instructor. Staff.

Designed to give graduate students teaching experience through involvement in planning and teaching courses under the supervision of departmental faculty members. The experience may include leading discussion sections, preparing, assisting in, or teaching lectures and laboratories, and tutoring. Students are expected to actually teach at least one hour per week for each credit awarded. Students cannot receive both pay and credit for the same hours of preparation and teaching.

**ARME 699 M.P.S. Research**

1-6 credits. Prerequisite: registration as an M.P.S. student. Credit is granted for the M.P.S. project report. Staff.

**ARME 700 Individual Study in Agricultural, Resource, and Managerial Economics**

Fall or spring. Limited to graduate students. S-U grades optional. Credit, class hours, and other details arranged with a faculty member. Staff.

This course is used for special projects designed by faculty members. More than one topic may be given each semester in different sections. The student must register in the section appropriate to the topic being covered; the section number is provided by the instructor.

**[ARME 708 Advanced Production Economics**

Fall. 3 credits. Prerequisite: ARME 608, 710, or equivalents; ECON 509 is highly recommended. Offered alternate years. Not offered fall 1996 and 1998. Next offered fall 1997. Hours to be arranged.  
R. N. Boisvert.

Theoretical and mathematical developments in production economics, with emphasis on estimating production relationships, scale economies, technical change, factor substitution. Developments in flexible functional forms, duality and dynamic adjustment models are emphasized. Discussions of other topics (risk, supply response, and household production functions) based on student interest.]

**ARME 710 Econometrics I**

Spring. 4 credits. Prerequisite: matrix algebra and statistics at the level of BTRY 417 and 601 (BTRY 408-409 preferred). Undergraduates must have permission of instructor. Lec, T R 2:30-4:25.  
W. G. Tomek.

This intermediate-level course covers selected statistical models and associated estimators used in econometrics; dynamic and other stochastic regressor models, seemingly unrelated regression and simultaneous equation models, and models with nonspherical error terms and specification errors. Students seeking an introduction to econometrics should take ARME 411.

**ARME 711 Econometrics II**

Fall. 4 credits. Prerequisite: ARME 710 or equivalent. BTRY 417 recommended.  
Lecs, M W 10:10-12:05. T. D. Mount.

Coverage beyond that of ARME 710 of linear regression models, including alternative methods of incorporating non-sample information and testing restrictions, diagnostic techniques for collinearity and influential observations, pooling data, stochastic coefficients, limited dependent variables and latent variables.

**ARME 712 Quantitative Methods I**

Fall. 4 credits. Prerequisite: some formal training in matrix algebra. A course at the level of BTRY 417 is highly recommended.  
Lecs, M W 8-9:55; sec, F 8-9:55.  
R. N. Boisvert.

A comprehensive treatment of linear programming and its extensions, including postoptimality analysis. Topics in nonlinear programming, including separable, spatial equilibrium and risk programming models. Input-output models and their role in social accounting matrices and computable general equilibrium models are discussed. Applications are made to agricultural, resource, and regional economic problems.

**ARME 713 Quantitative Methods II**

Spring. 4 credits. Prerequisites: ECON 509 and ARME 710. Lec, M W 9:05-11.  
J. M. Conrad and T. D. Mount.

This course is concerned with the analysis and optimization of dynamic systems. Course objectives are to (1) present the basic theory of dynamical systems and dynamic optimization, (2) introduce associated methods of numerical and econometric analysis, (3) review some applications of dynamic analysis from various subfields in economics, and thereby (4) equip students with basic theory and methods to perform applied research on dynamic allocation problems.

**[ARME 714 Experimental Economics**

Fall. 4 credits. Prerequisites: ECON 509. Offered alternate years. Not offered fall 1996 and 1998. Next offered fall 1997.  
Lecs, T R 10:10-11:25. W. D. Schulze.

The course will survey both experimental economics methods and research as an approach to test economic theory. Students will participate as subjects in a series of illustrative computerized experiments ranging from double auctions to public goods provision. Topics covered include experimental methods; decisions and games; markets (testing auction institutions); market power (monopoly, oligopoly); bargaining, compensation and performance; public goods; externalities, and voting; information and uncertainty; and economic anomalies. Students must design, implement, and write a



paper describing their own experiment testing an economic theory.]

#### **ARME 717 Research Methods in Agricultural Economics**

Spring. 2 credits. Limited to graduate students. M 1:25–3:20. R. N. Boisvert. Discussion of the research process and scientific method as applied in agricultural economics. Topics include problem identification, hypotheses, sources of data, sampling concepts and designs, methods of collecting data, questionnaire design and testing, field organization, and analysis of data. During the semester each student develops a research proposal that may be associated with his or her thesis.

#### **[ARME 730 Seminar on International Trade Policy: Agriculture, Resources and Development]**

Spring. 3 credits. Limited to graduate students. Prerequisites: ARME 630 or equivalent. Offered alternate years. Not offered spring 1997. Next offered spring 1998. Hours to be arranged. D. R. Lee.

This course examines selected topics in the professional literature on international trade policy, focusing on agricultural trade and related topics, including trade liberalization, trade and environmental linkages, technological change and trade policy, and agricultural trade and development.]

#### **ARME 731 Seminar on Agricultural Policy**

Fall. 3 credits. Limited to graduate students. Offered alternate years. Offered fall 1996 and 1998. Not offered fall 1997. T R 12:20–1:50. H. de Gorter.

A review of the professional literature relating to agricultural policy issues and techniques appropriate to the analysis of such issues.

#### **ARME 740 Agricultural Markets and Public Policy**

Spring, weeks 1–7. 2 credits. Limited to graduate students. Prerequisite: familiarity with multiple regression techniques at the ARME 411 level or higher. Recommended: ARME 640. T R 12:20–2:15. W. H. Lesser.

Develops the concepts and methodology for applying and analyzing the effects of public-policy directives to the improvement of performance in the U.S. food marketing system. Prospective topics include a survey of industrial organization principles, antitrust and other legal controls, and coordination systems in agriculture. Topics can be adjusted to students' interests.

#### **ARME 741 Space, Trade, and Commodity Analysis**

Spring, weeks 8–14. 2 credits. Limited to graduate students. Recommended: ARME 412 or equivalent and ARME 640. T R 12:20–2:15. J. E. Pratt.

Principal topics are spatial micro-economics of the firm, spatial pricing and location decisions, the forms of spatial competition, and quantitative methods for spatial analyses, which include techniques for finding spatial equilibria and selected network optimization algorithms.

#### **ARME 750 Resource Economics**

Spring. 4 credits. Prerequisites: ECON 509 and 518, or ARME 713. Lects, T R 2:30–4:20. J. M. Conrad.

Optimal control and other methods of dynamic optimization will be used to study the allocation and management of natural resources.

#### **ARME 751 Environmental Economics**

Fall. 4 credits. Prerequisites: ECON 509 and 518, or ARME 713. S-U grades optional. Lects, T R 2:30–4:20. J. M. Conrad and L. D. Chapman.

Economic theory will be applied to the problems of managing environmental quality. Static and dynamic models of externality, decisions to preserve or develop natural environments, and methods of valuation will be presented.

#### **ARME 754 Sociotechnical Aspects of Watershed Development (also Agricultural and Biological Engineering 754, and Government 644)**

Spring. 2 or 3 credits. S-U grades optional. W 7–9:30 p.m. T. Steenhuis, M. Walter, N. Uphoff, and staff. For description, see ABEN 754.

#### **ARME 763 Macro Policy in Developing Countries**

Spring. 3 credits. Prerequisites: ECON 509, 510, 513 (may be taken concurrently), or permission of instructor. Offered alternate years. Offered spring 1997; not offered spring 1998. Lec, T 2–4:25. S. C. Kyle.

This course examines macroeconomic policies in developing countries and their interaction with economic growth, development, and stability. Theoretical models useful for analysis of macro policies will be covered as well as an examination of empirical studies. Emphasis will be on research topics of current interest to students and professionals in the field, particularly those relating to the interaction of macro policy with micro and sectoral analysis.

## **ANIMAL SCIENCE**

H. F. Hintz, chair; B. J. Apgar, R. E. Austic, D. E. Bauman, D. H. Beermann, A. W. Bell, R. W. Blake, Y. R. Boisclair, D. L. Brown, W. R. Butler, L. E. Chase, G. F. Combs, W. B. Currie, H. N. Erb, R. W. Everett, D. G. Fox, D. M. Galton, R. C. Gorewit, D. E. Hogue, P. A. Johnson, L. R. Jones, K. Keshavarz, X. G. Lei, E. A. Oltenacu, P. A. Oltenacu, J. E. Parks, A. N. Pell, E. J. Pollak, R. L. Quaas, S. M. Quirk, J. B. Russell, R. D. Smith, M. L. Thonney, M. E. Van Amburgh, D. R. Van Campen

#### **AN SC 100 Domestic Animal Biology I**

Fall. 4 credits. S-U grades optional. Lects, M W F 9:05; sec, T W or R 2–4:25. W. B. Currie, M. L. Thonney, and staff.

An introduction to the science of raising animals in the context of commercial animal production. Lectures and labs address the biology of economically important species (morphology, anatomy, and physiology) and application of the biology to the management of animals within major livestock industries. Topics covered include fundamentals of anatomy, regulatory mechanisms, vital systems, digestion, and metabolism. Students care for small numbers of cattle, sheep, pigs, and chickens in different phases of their life cycle to maximize hands-on contact. Living animals will be used noninvasively, and fresh organs and tissues from dead animals will be used in laboratories.

#### **AN SC 105 Contemporary Perspectives of Animal Science**

Spring. 1 credit. Limited to freshmen, sophomores, and first-year transfers. T 1:25 or W 12:20. R. C. Gorewit and D. J. Cherney.

A forum to discuss the students' career planning and the contemporary and future role of animals in relation to human needs.

#### **AN SC 120 Animal Domestication and Behavior**

Fall. 3 credits. T R 8:40–9:55. E. A. Oltenacu.

This Freshman Writing Seminar will explore the relationship between humans and their domestic animals. Students will study the role of animal behavior in the domestication process, both historically and in modern attempts to domesticate new species, and in finding solutions to current issues related to animal welfare.

#### **AN SC 150 Domestic Animal Biology II**

Spring. 4 credits. S-U grades optional. Lec, M W F 9:05; lab/disc T W or R 2–4:25. W. R. Butler and staff.

Second of a two-semester sequence (100/150) applying the basic biology of growth, defense mechanisms, reproduction, and lactation to aspects of the production and care of domestic animals. Fresh tissues and organs from dead animals along with preserved specimens will be used in laboratories, exercises, and demonstrations.

#### **AN SC 212 Animal Nutrition**

Fall. 4 credits. Prerequisite: CHEM 104 or 208. Recommended: AN SC 100 and 150. Lects, M W F 10:10; lab, M T W R or F 1:25–4:25. A. W. Bell.

An introduction to animal nutrition, including digestive physiology and metabolism of livestock and other species; nutrient properties and requirements for different aspects of animal production; principles of feed evaluation and ration formulation. Laboratory classes include gastrointestinal tract dissections and a nutritional experiment performed on a laboratory or farm animal species.

#### **AN SC 213 Nutrition of Companion Animals**

Spring, weeks 1–7. 1 credit. Prerequisite: AN SC 212 or equivalent. Offered alternate years. Next offered spring 1997, 1999. Lects W 7:30–9:25 p.m. H. F. Hintz.

Nutrition of companion animals, with emphasis on the dog and cat. Digestive physiology, nutrient requirements, feeding practices, and interactions of nutrition and disease.

#### **[AN SC 214 Nutrition of Exotic Animals]**

Spring, weeks 1–7. 1 credit. Prerequisite: AN SC 212. Offered alternate years. Offered spring 1998. Lec, W 7:30–9:25 p.m. H. F. Hintz.

Principles of nutrition for exotic animals including birds and fish. Nutrient requirements, sources of nutrients, feeding management systems, and ration formulation will be discussed. Signs of nutrient deficiencies and excesses will be described.]

**AN SC 215 Exotic Avian Husbandry and Propagation**

Spring. 2 credits. Limited to 100 students.  
Prerequisites: AN SC 100, 150 or Bio G 103, 104 or equivalent. Lec, M 2:30-4:30.  
J. Parks and D. Muscarella.

Natural history, care, management, health and breeding of exotic avian species with emphasis on psittacines (parrots and related species) and raptors (birds of prey). Lectures, demonstrations, and local field trips.

**AN SC 221 Introductory Animal Genetics**

Spring. 3 credits. Prerequisite: a year of college biology. Lec, T R 9:05; sec, T W R or F 2-4:25. E. J. Pollak.

An examination of basic genetic principles and their application to the improvement of domestic animals, with emphasis on the effects of selection on animal populations.

**AN SC 230 Poultry Biology**

Spring. 3 credits. Prerequisites: AN SC 100 and 150 or introductory biology.  
Offered alternate years. Not offered spring 1998; next offered spring 1997, 1999. Lec, T R 11:15; lab, M 2-4:25. R. E. Austic.

A course designed to acquaint the student with principles of avian biology and their application in the various aspects of poultry production. Some laboratory sessions involve dissection and/or the handling of live birds.

**AN SC 250 Dairy Cattle Principles**

Fall. 3 credits. S-U grade optional. Lec, T R 10:10; lab, W or R 2-4:25.  
D. M. Galton and T. Batchelder.

Introduction to the background and scientific principles relating to dairy cattle production. Laboratories are designed to provide an understanding of production techniques. This course is a prerequisite for AN SC 351 and AN SC 455.

**AN SC 251 Dairy Cattle Selection**

Spring. 2 credits. Prerequisite: AN SC 250 or equivalent. S-U grades optional. Lec, W 1:25-2:15; lab, W 2:15-4:25.  
D. M. Galton.

Application of scientific principles of genetic programs in herds with different breeding programs. Emphasis on economical traits to be used to improve genetic progress and herd profitability.

**AN SC 265 Horses**

Spring. 3 credits. Prerequisites: AN SC 100 and 150 or permission of instructor. S-U grades optional. Lec, T R 10:10; lab, R 1:25-4:25. C. Collyer.

Selection, management, feeding, breeding, and training of light horses.

**AN SC 290 Meat Science (also Food Science 290)**

Fall. 2 or 3 credits. Lec, T R 11:15; lab, M or R 12:20-3:20. D. H. Beermann and staff. Lecture only, 2 credits; lecture plus lab, 3 credits.

An introduction to meat science through a study of the structure, composition, and function of muscle and its conversion to meat. Properties of fresh and processed meat, microbiology, preservation, nutritive value, inspection, and sanitation are also studied. Laboratory exercises include anatomy, meat-animal slaughter, meat cutting, wholesale and retail cut identification, inspection, grading, curing, sausage manufacture and quality control. An all-day field trip to commercial meat plants is taken.

**AN SC 300 Animal Reproduction and Development**

Spring. 3 credits. Prerequisite: AN SC 100-150 or equivalent and one year of introductory biology. Lec, M W F 10:10.  
J. E. Parks.

Comparative anatomy and physiology of mammalian and avian reproduction, with emphasis on domestic and laboratory animals. Fertilization through embryonic development, pregnancy, and growth to sexual maturity; emphasis on physiological mechanisms and application to fertility regulation. Separate laboratory offered to demonstrate fundamental aspects of reproduction and reproductive technology.

**AN SC 301 Animal Reproduction and Development Lab**

Spring. 1 credit. Prerequisite: AN SC 100-150 or equivalent. Concurrent enrollment in or completion of AN SC 300 required to register. Labs, M W or F 1:25-4:25. Each lab limited to 30 students.  
J. E. Parks.

Demonstration of fundamental principles and applied aspects of mammalian and avian reproduction. A limited number of live animals will be used in some demonstrations. Dissection and examination of tissues from vertebrate animals will be included in selected laboratories.

**AN SC 305 Farm Animal Behavior (also BIOAP 312)**

Spring. 2 credits. Prerequisites: introductory course in animal physiology; at least one animal production course or equivalent experience is recommended. S-U grades optional. Lec, T R 11:15.  
E. A. Oltenacu and K. A. Houpt.

The behavior of production species (avian and mammalian) influences the success of any management program. Students study behaviors relating to communication, learning, social interactions, reproduction, and feeding of domestic animals and their physiological basis. Management systems for commercial livestock production and their implications for animal behavior and welfare are stressed.

**AN SC 312 Applied Cattle Nutrition**

Spring. 4 credits. Prerequisites: AN SC 100 and 212 (or equivalent) Dairy Fellows enroll during senior year after AN SC 455. Lec, M W F 10:10; lab, M or T 1:25-4:25.  
M. E. Van Amburgh.

An applied approach to predicting nutrient requirements and feed utilization to meet requirements with wide variations in cattle type, feed composition, and environmental conditions. Dairy cattle are emphasized. Nutrient management to minimize cost of production and environmental effects is discussed. Computer models (Cornell Net Carbohydrate and Protein System) are used in the laboratory to apply the information presented in lectures, including evaluation of feeding programs on case study farms. Course is designed for advanced juniors, seniors, and entering graduate students.

**AN SC 321 Applied Animal Genetics Seminar**

Spring. 1 credit. Prerequisite: AN SC 221 or equivalent. S-U grades only. Lec, M 9:05. P. A. Oltenacu and E. J. Pollak.

Topics of interest related to the genetic definition and control of qualitative and quantitative traits in various species of animals are presented. Current animal improvement

strategies as well as challenges presented by new developments in reproductive biology and molecular genetics are addressed in a lecture discussion-type format.

**AN SC 322 Applied Animal Genetics-Laboratory**

Spring. 1 credit. Prerequisite: concurrent registration in AN SC 321 or instructor's permission. S-U grades only. M 2-4:25.  
P. A. Oltenacu and E. J. Pollak.

Many genetic concepts addressed in AN SC 321 are explored in depth using a computer-assisted instruction environment. Mendelian inheritance of qualitative traits, detection of carriers of recessive genes, artificial selection, inbreeding and heterosis, design and evaluation of genetic improvement and conservation programs, and role of population size are among the topics considered.

**[AN SC 330 Commercial Poultry Production]**

Spring. 2 credits. Prerequisites: AN SC 100, 150, and 230 or permission of instructor. Offered alternate years. Not offered 1997. Next offered spring 1998. Lec, F 2-4 (occasional field trips run past 4 p.m.) K. Keshavarz.

The course emphasizes production and business management aspects of commercial poultry farm operation and is designed to acquaint the student with current technology involved in commercial poultry production.]

**AN SC 341 Physiology of Lactation**

Spring. 3 credits. Prerequisite: AN SC 150 or AN SC 300 or equivalent. Lec, T R 9:05; lab R 2-4:25. Staff.

The physiology of milk production is covered with emphasis on mammary gland development, anatomy, hormonal control of milk secretion, and the biosynthesis of milk constituents. The dairy cow serves as the model system, but all livestock species are considered.

**AN SC 351 Dairy Herd Management**

Spring. 4 credits. Prerequisites: AN SC 250 or permission of instructor. Recommended: ARME 302. Lec, M W F 11:15; labs, M or T 1:25-4:25, and F (alternate weeks) 1:25-4:25. D. M. Galton and staff.

Application of scientific principles to practical herd management with components of reproduction, milking, housing, records, and production economics. Laboratories emphasize practical applications, analyses of alternatives, decision making, field trips, and discussion.

**AN SC 360 Beef Cattle**

Spring. 3 credits. Limited to 32 students. Lec, T R 10:10; lab, W 2-4:25.  
M. L. Thonney.

Emphasis is on the management of reproduction, nutrition, and selection in beef cattle enterprises. A cattle growth model is studied. Laboratories acquaint students with the management skills through computerized simulations and working directly with cattle. Students are required to spend several days during the semester feeding and caring for cattle and observing calving.

**[AN SC 370 Swine Nutrition and Management]**

Fall. 3 credits. Recommended: AN SC 212. Offered alternate years. Not offered fall 1996, 1998. Next offered fall 1997. Lec, T R 11:15; lab, T 2-4:25. X. G. Lei and K. Roneker.

This course focuses on swine nutrition, feeding, and management. Lectures are integrated basic nutrition and swine system including pig biology, digestive and metabolic development, nutritional biochemistry and physiology, impact of swine nutrition on environment, use of pig model in medicine, and current swine nutrition and biotechnology. Laboratory practice, animal projects, and problem troubleshooting are offered.]

#### AN SC 380 Sheep

Fall. 3 credits. Lec, T R 9:05; sec, W 1:25-4:25 every other week. D. E. Hogue. The breeding, feeding, management, and selection of sheep from a production-system approach. Lectures and laboratories are designed to give students a practical knowledge of sheep production as well as the scientific background for improved practices.

#### AN SC 392 Animal Growth Biology

Fall. 2 credits. Not open to freshmen; sophomores by permission of instructor only. Prerequisites: one year of college biology and one course in animal or human physiology, AN SC 212 and 221. Lec, R 1:25-3:20; sec, F 1:25-2:15. D. H. Beermann and staff.

A detailed discussion of the morphological and physiological aspects of growth of domestic and laboratory animals. Overview of the cell cycle and early embryo growth regulation, differentiation and cellular aspects of tissue development and growth, maternal influences on fetal growth and allometric patterns of postnatal growth are discussed. Endocrine, genetic and nutritional influences on protein and lipid metabolism, nutrient requirements and composition of growth will be emphasized.

#### AN SC 400 Tropical Livestock Production

Spring. 3 credits. Prerequisite: Upperclass standing. Lec, T R 9:05; disc, W 1:25-3:20. R. W. Blake. An analysis of constraints on livestock production in developing countries of the tropics, economic objectives and risk, and production methods. Emphasis is on strategic use of animal and plant resources, animal performance with inputs restricted, decision making, and alternative systems of production. Principles, real examples, independent study projects, and classroom interactions will aid problem-solving efforts to improve food security.

#### AN SC 401 Dairy Production Seminar

Spring. 1 credit. Limited to juniors and seniors. Disc, M 7 p.m. D. E. Bauman. Capstone course where students, with the help of faculty members, complete a study of the research literature on topics of current interest in the dairy industry. Students then make an oral and a written report on their topic with emphasis on integrating theory and practice.

#### AN SC 402 Seminar in Animal Sciences

Spring. 1 credit. Limited to juniors and seniors. May be repeated. S-U grades optional. Lec, M 4:30. P. A. Johnson and W. B. Currie.

Review of literature pertinent to topics of animal science or reports of undergraduate research and Honors projects. Students present oral reports of their work for class discussion in addition to written reports.

#### AN SC 403 Tropical Forages

Spring. 2 credits. Limited to seniors and graduate students except by permission of instructor. Prerequisites: crop production and livestock nutrition. Offered alternate years. Not offered 1998. Next offered spring, 1997. Lec, T R 12:20. A. N. Pell. An overview of tropical grasslands, seeded pastures, and crop residues as feed resources; grass and legume characteristics; establishment and management of pastures; determination of feeding value forages and crop residues; physiology of digestion of ruminants that affects feeding behavior of various species; problems of chemical inhibitors in plants; and utilization of tropical forages as hay or silage.

#### AN SC 410 Nutritional Physiology and Metabolism

Fall. 3 credits. Prerequisites: biochemistry and physiology. M W F 11:15. R. E. Austic and D. E. Bauman. A fundamental approach to nutrition focusing on the metabolic rate of nutrients and the interrelationships among nutrients, nutritional state, and metabolic processes. The overall goal is to increase understanding of metabolism and metabolic regulation through an integration of nutrition, biochemistry, and physiology.

#### AN SC 414 Ethics in Animal Science

Fall. 2 credits. Enrollment limited to 40. Juniors and seniors only. If enrollment exceeds 40, preference will be given to seniors. Lec, M 12:20; disc, W or F 12:20-1:10. One evening movie (7-9 pm, Oct. 2): Susceptible to Kindness, Miss Ever's Boys. The Tuskegee Syphilis Study. One Saturday mandatory farm tour (9 am-1 pm, Sept. 28). D. J. Cherney and A. Van Tienhoven.

Exploration of the place of humans in the biological world, the origin and development of ethics and morality and to what extent human rights should be extended to nonhuman animals. A book review, participation in discussions, and the performance of a task (selected from four options) will be the basis for the grade earned.

#### AN SC 415 Poultry Nutrition

Spring. 1 credit. Prerequisite: AN SC 212 or permission of instructor. Offered alternate years. Not offered spring 1998; next offered spring 1997, 1999. Lec, F 11:15. R. E. Austic.

A practical consideration of principles of nutrition applied to feeding poultry, including use of linear programming techniques in diet formulation.

#### AN SC 420 Quantitative Animal Genetics

Fall. 2 credits. Prerequisite: AN SC 221 or equivalent. Limited to 30 students. Lec, T 11:15; sec, R 2-4:25. E. J. Pollak.

A consideration of problems involved in improvement of animals through application of the theory of quantitative genetics, with emphasis on genetic evaluation and analysis of data for genetic parameters. Computer labs use interactive matrix algebra program for problem solving.

#### AN SC 425 Gamete Physiology and Fertilization

Fall. 2 credits. Limited to 50 students. Prerequisite: AN SC 300 or equivalent. Offered alternate years. Not offered fall 1996; next offered fall 1997. Lec, R 2:30-4:25. J. E. Parks.

Study of the formation, growth, differentiation, and maturation of mammalian sperm and oocytes; gamete transport and interaction with male and female reproductive tracts; and cytological, physiological, and molecular changes required for fertilization. Lecture, discussion, and demonstration of selected aspects of gamete physiology and *in vitro* technologies such as oocyte maturation and fertilization.]

#### AN SC 427 Fundamentals of Endocrinology

Fall. 3 credits. Prerequisite: animal or human physiology or permission of instructor. Lec, M W F 9:05. P. A. Johnson.

Physiology and regulation of endocrine secretions. Neuroendocrine, reproductive, growth, and metabolic aspects of endocrinology are emphasized. Examples are selected from many animals, including humans.

#### AN SC 455 Dairy Nutrition and Health

Fall. 3 credits. Prerequisite: AN SC 351 and permission of instructor. S-U grades optional. Lec, T R 11:15; lab, M or T 1:25-4:25; and F (alternative weeks) 1:25-4:25. D. M. Galton, L. E. Chase and T. Batchelder.

Application of scientific principles to practical herd management with components of nutrition and herd health. Laboratories emphasize practical applications, analyses of alternatives, decision making, field trips, and discussion.

#### AN SC 456 Dairy Management Fellowship

Spring. 2 credits. Limited to seniors. Prerequisites: AN SC 351 and 455, and permission of instructor. S-U grades only. Hours to be arranged. D. M. Galton and T. Batchelder.

The program is designed for undergraduates who have a sincere interest in dairy farm management. Objectives are to gain further understanding of the integration and application of dairy farm management principles and programs with respect to progressive dairying and related industries.

#### [AN SC 457 Livestock Fellowship

Spring. 2 credits. Prerequisite: permission of instructor. Not offered spring 1997. S-U grades only. Lec, F 1:00-4:25.

A program for students with particular interests in meat animal production, beef cattle, sheep, and swine. Objectives are to gain a more thorough understanding of the production of these species and their integration in various farm management situations. Students will participate in extension education programs and have contact with representative livestock producers as well as the agribusiness organizations important to livestock production.]

#### [AN SC 490 Commercial Meat Processing

Spring. 2 or 3 credits. Prerequisite: AN SC 290 or permission of instructor. Offered alternate years. Not offered spring 1997. Next offered spring 1998. Lec, T R 9:05; lab, T 1:25-4:25. Lecture only, 2 credits; lecture and lab, 3 credits. Field trip to commercial meat processing plants. D. H. Beermann.

A study of the classification, formulation, and production of commercially available processed meat products. Physical and chemical characteristics of meat and nonmeat

ingredients; their functional properties; various processing methodologies; microbiology; packaging, handling, and storage; and quality assurance are discussed.]

#### **AN SC 494 Special Topics in Animal Science**

Fall or spring. 4 credits maximum.  
Prerequisite: undergraduate standing.  
S-U grades optional. Staff.

The department teaches "trial" courses under this number. Offerings vary by semester and will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

#### **AN SC 496 Animal Sciences Honors Seminar**

Fall weeks 1-8. 1 credit. S-U grades only. Students must be accepted into the Animal Sciences Honors Program. Disc, M 2:30-4:00. W. B. Currie.

The course is designed to provide information and guidance for students enrolled in the honors program in animal sciences and expecting to complete an honors thesis. The following topics will be presented and discussed: requirements and expectations of the honors program, formulating hypotheses, the scientific method, literature search techniques ethics in science, and scientific communication. Students are required to make verbal presentations.

#### **AN SC 497 Individual Study in Animal Science**

Fall or spring. 1-3 credits; may be repeated for credit. Intended for students in animal sciences. Prerequisite: permission of instructor. Students must register with an Independent Study form (available in 140 Roberts Hall). S-U grades optional. Staff.

May include individual tutorial study or a lecture topic selected by a professor. Since topics may change, the course may be repeated for credit.

#### **AN SC 498 Undergraduate Teaching**

Fall or spring. 1, 2 or 3 credits; limited to two experiences during undergraduate career. Limited to students with grade-point averages of at least 2.7. Students must register with an Independent Study form (available in 140 Roberts Hall).

Designed to consolidate the student's knowledge. A participating student assists in teaching a course allied with the student's education and experience. The student is expected to meet regularly with a discussion or laboratory section, to gain teaching experience, and regularly to discuss teaching objectives, techniques, and subject matter with the professor in charge.

#### **AN SC 499 Undergraduate Research**

Fall or spring. 6 credits maximum during undergraduate career. Not open to students who have earned 6 or more undergraduate research credits elsewhere in the college. Limited to juniors and seniors with grade-point averages of at least 2.7. Students must register with an Independent Study form (available in 140 Roberts Hall).

Affords opportunities for students to carry out independent research under appropriate supervision. Each student is expected to review pertinent literature, prepare a project outline, conduct the research, and prepare a report.

#### **[AN SC 601 Amino Acids (also NS 601)]**

Spring. 2 credits. Prerequisites: physiology, biochemistry, and nutrition. Offered alternate years. Not offered spring 1997; next offered spring 1998. Lec, W F 12:20. R. E. Austic.

A course emphasizing the dynamic aspects of protein digestion and absorption, amino acid transport and amino acid and nitrogen metabolism, and their relationships to the requirements for amino acids.]

#### **AN SC 603 Mineral Nutrition: Metabolic, Health, and Environmental Aspects (also NS 603)**

Fall. 2 credits. Prerequisites: Biochemistry, physiology, and nutrition. Offered alternate years. Next offered fall 1996. Lec M W 10:10. X. G. Lei and G. F. Combs Jr.

A revised course emphasizing the metabolic roles and environmental impacts of mineral nutrition in animal, human, and food systems. Team-taught lectures include general biochemical and physiological aspects of mineral metabolism and specific mechanisms of gene expression, regulation, and mammal health disorders associated with individual elements. Methodology and facility of mineral research is also discussed.

#### **AN SC 604 Vitamins**

Fall. 2 credits. Lec, T R 10:10.  
G. F. Combs, Jr.

The biochemical, physiological, and clinical aspects of the vitamins presented in an interactive discussion-based format.

#### **AN SC 610 Seminar**

Fall and spring. 1 credit. S-U grades only.

#### **AN SC 619 Field of Nutrition Seminar**

Fall and spring. No credit. No grades given.

Lectures on current research in nutrition.

#### **AN SC 620 Seminar in Animal Breeding**

Fall and spring. 1 credit. Limited to graduate students with a major or minor in animal breeding. S-U grades only. Hours to be arranged.

#### **AN SC 621 Seminar: Endo/Reprod Biology**

Fall and spring. 1 credit. Prerequisites: Permission of instructor. Registration limited to graduate students. S-U grades only. Lec, W 4:00. W. R. Butler and staff.

Current research in reproductive physiology is presented by staff members, graduate students, and visitors.

#### **AN SC 625 Nutritional Toxicology**

Spring. 2 credits. Prerequisites: Biochemistry and nutrition courses. S-U grades optional. Lec T 2:30-4:25. D. L. Brown.

Toxic doses of nutrients and interference with the metabolism of nutrients by other toxic compounds represent the two principal branches of the course. Introduction to poisonous plants and general toxicology will be provided. Course will focus on toxicants found in feeds and foods.

#### **AN SC 630 Bioenergetics/Nutritional Physiology**

Spring. 3 credits. Prerequisites: AN SC 410 and biochemistry or physiology, or permission of instructor. S-U grades optional. Offered alternate years. Next offered spring 1997, 1999. Lec, M W F 10:10. A. W. Bell and D. E. Bauman.

An integrated systems approach to the nutritional physiology and energy metabolism of productive animals. Emphasis on extracellular regulation of tissue and organ metabolism of specific nutrients in relation to pregnancy, lactation, and growth. Critical discussion of techniques and approaches to the study of animal bioenergetics.

#### **AN SC 640 Individual Study in Animal Science**

Fall or spring. 1 or more credits. S-U grades optional. Hours to be arranged. Staff.

Study of topics in animal science more advanced than, or different from, other courses. Subject matter depends on interests of students and availability of staff.

#### **AN SC 650 Molecular Techniques for Animal Biologists**

Spring. 4 credits. Prerequisites: BIOBM 330 or BIOBM 332 or BIOBM 333 or equivalents and permission of instructors. Enrollment limited to 15 students. Lec, T 11:15; labs, T and R 1:25-4:25. Y. Boisclair and S. Quirk.

A laboratory course designed for students with little or no experience with techniques in molecular biology. Emphasis will be on techniques used in conducting research in nutrition and physiology (e.g., subcloning, mutagenesis of DNA, RT-PCR, DNA sequencing and analysis, analysis of gene expression, protein expression). Animal science and mammalian biology provide the context to the experiments. Lectures will introduce laboratory exercises, supplement laboratory topics, and discuss selected readings from the literature. Students will perform an independent project requiring time outside scheduled laboratories and will give a scientific presentation.

#### **AN SC 694 Special Topics in Animal Science**

Fall or spring. 4 credits maximum.  
Prerequisite: graduate standing. S-U grades optional.

The department teaches "trial" courses under this number. Offerings vary by semester and will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

#### **[AN SC 720 Advanced Quantitative Genetics]**

Spring. 3 credits. Prerequisites: matrix algebra, linear models, and mathematical statistics. S-U grades optional. Offered alternate years. Not offered spring 1997; next offered spring 1998. Hours to be arranged. R. L. Quaas.

Estimation of genetic and environmental parameters required to design efficient selection programs. Emphasis is given to interpretation of experimental and survey data with unequal subclass numbers, and prediction of genetic progress resulting from alternative selection methods.]

#### **AN SC 800 Master's-Level Thesis Research**

Fall or spring. Credit to be arranged, maximum 12 credits/semester. Prerequisite: permission of adviser. S-U grades only. Graduate faculty.

For students admitted specifically to a Master's program.



**AN SC 900 Graduate-Level Thesis Research**

Fall or spring. Credit to be arranged, maximum 12 credits/semester. Prerequisite: permission of adviser. S-U grades only. Graduate faculty.

For students in a Ph.D. program **only before** the 'A' exam has been passed.

**AN SC 901 Doctoral-Level Thesis Research**

Fall or spring. Credit to be arranged, maximum 12 credits/semester. Prerequisite: permission of adviser. S-U grades only. Graduate faculty.

For students admitted to candidacy after the 'A' exam has been passed.

**Related Courses in Other Departments**

Introductory Animal Physiology (BIOAP 311)

Introductory Animal Physiology Laboratory (BIOAP 319)

Milk Quality (FOOD 351)

Agriculture in the Developing Nations (INTAG 602)

Lipids (NS 602)

Basic Immunology, Lectures (BIOBM 305)

Basic Immunology, Laboratory (BIOBM 307)

**BIOLOGICAL SCIENCES**

The program of study in biology is offered by the Division of Biological Sciences. For course descriptions, see the section on the Division of Biological Sciences.

**BIOMETRY AND STATISTICS**

C. Castillo-Chavez, chair; N. S. Altman, G. Casella, G. A. Churchill, M. Contreras, S. Holmes, C. E. McCulloch, S. J. Schwager, S. R. Searle

Courses in biometry and statistics are offered by the Biometrics Unit in the Department of Plant Breeding and Biometry.

**BTRY 101 Introduction to Biometry I**

Fall. 4 credits. S-U grades optional.

Prerequisites: ALS 115 or equivalent.

An introductory survey course in the use of mathematics, computing, and probability and statistics in the biological sciences. Case studies are used to develop the ideas of statistics, curve fitting, elementary matrix algebra, basic probability, and differentiation. Selected topics in differential and difference equations and integration will also be covered. A symbolic mathematics and graphics package (e.g., Maple or Mathematica) will be taught and used throughout the course.

**BTRY 102 Introduction to Biometry II**

Spring. 4 credits. S-U grades optional.

Prerequisite: BTRY I or equivalent.

This course is the continuation of Biometry 101 (formerly 102). It provides a more in-depth view of the use of mathematics, computing, probability and statistics in the biological sciences. Topics covered include discrete and continuous models, applications of differential and integral calculus, optimization methods, matrix algebra, and Markov models.

**BTRY 200 Statistics and the World We Live In**

Spring. 3 credits.

Major concepts and approaches of statistics are presented at an introductory level. Three broad areas are covered: collecting data, organizing data, and drawing conclusions from data. Topics include sampling, statistical experimentation and design, measurement, tables, graphs, measures of center and spread, probability, the normal curve, confidence intervals, and statistical tests.

**BTRY 215 Introduction to Statistical Methods**

Fall. 3 credits. Prerequisite: BTRY 200 is recommended for students with no prior experience in data collection and interpretation.

Statistical methods are developed and used to analyze data arising from the biological sciences. Topics include point and confidence interval estimation, hypothesis testing, t-tests, correlation, simple linear regression, and analysis of variance and multiple regression. Statistical computing is taught and used throughout the course. Emphasis is on proper use of statistical methodology and interpretation of statistical analyses.

**BTRY 400 Biometry Seminar**

Fall and spring. 1 credit. S-U grades only.

Students will attend weekly seminar, the Biometrics Unit Discussion Series. Can be taken concurrently with BTRY 600 only with permission of instructor.

**BTRY 408 Theory of Probability**

Fall. 4 credits. Prerequisite: MATH 112, 122, or 192, or permission of instructor.

An introduction to probability theory: foundations, combinatorics, random variables and their probability distributions, expectations, generating functions, and limit theory. Biological and statistical applications are the focus. Can serve as either a one-semester introduction to probability or a foundation for a course in the theory of statistics.

**BTRY 409 Theory of Statistics**

Spring. 4 credits. Prerequisite: BTRY 408 or equivalent.

The concepts developed in BTRY 408 are applied to provide an introduction to the classical theory of parametric statistical inference. Topics include sampling distributions, parameter estimation, hypothesis testing, and linear regression. Students seeking applied courses in statistical methodology should consider BTRY 601–602 or BTRY 215.

**BTRY 417 Matrix Algebra**

Fall. 3 credits. Prerequisite: precalculus mathematics.

Definitions, basic operations and arithmetic, determinants, and the inverse matrix. Rank, linear dependence, canonical forms, linear equations, generalized inverses and eigenroots and vectors. Emphasis is on understanding basic ideas and on developing skills for applying matrix algebra.

**BTRY 451 Mathematical Modeling of Populations**

Fall. 3 credits. S-U grades optional.

Prerequisites: MATH 112, BTRY 408, or equivalent. Offered alternate years. Not offered 1997–98; offered fall 1996.

This course will emphasize stochastic and deterministic models relevant to population genetics and population biology. Computer simulations and use of mathematical packages will be an integral part of the course.

**BTRY 494 Undergraduate Special Topics in Biometry and Statistics**

Fall or spring. 1–3 credits. S-U grades optional.

A course of lectures selected by the faculty. Because topics usually change from year to year, this course may be repeated for credit.

**BTRY 495 Statistical Consulting**

Spring. 2 credits. S-U grades only.

Limited to undergraduates. Prerequisites or co-requisites: BTRY 409 and 602 and permission of instructor.

Participation in the Biometrics Unit consulting service: faculty-supervised statistical consulting with researchers from other disciplines. Discussion sessions for joint consideration of selected consultations encountered during previous weeks.

**BTRY 497 Undergraduate Individual Study in Biometry and Statistics**

Fall or spring. 1–3 credits. S-U grades optional.

Students must register with an Independent Study form (available in 140 Roberts Hall).

Consists of individual tutorial study selected by the faculty. Because topics usually change from year to year, this course may be repeated for credit.

**BTRY 498 Undergraduate Supervised Teaching**

Fall or spring. 2 credits. S-U grades only.

Students must register with an Independent Study form (available in 140 Roberts Hall).

Students assist in teaching a course appropriate to their previous training. Students will meet with a discussion or laboratory section and regularly discuss objectives with the course instructor.

**BTRY 499 Undergraduate Research**

Fall or spring. 1–3 credits. S-U grades optional.

Limited to statistics and biometry undergraduates. Prerequisite: permission of faculty member directing research.

Students must register with an Independent Study form (available in 140 Roberts Hall).

**BTRY 600 Statistics Seminar**

Fall and spring. 1 credit. S-U grades only.

Prerequisite or corequisite: BTRY 409 or permission of instructor.

**BTRY 601 Statistical Methods I**

Fall and summer. 4 credits. Limited to graduate students; others by permission of the instructor.

Statistical methods are developed and used to analyze data arising from a wide variety of applications. Topics include descriptive statistics, point and interval estimation, hypothesis testing, inference for a single population, comparisons between two populations, one- and two-way analysis of variance, comparisons among population means, analysis of categorical data, and correlation and regression analysis. Interactive computing is introduced through MINITAB statistical software. Emphasis is on basic principles and criteria for selection of statistical techniques.

**BTRY 602 Statistical Methods II**

Spring. 4 credits. Limited to graduate students; others by permission of instructor.

Prerequisite: BTRY 601 or equivalent.

A continuation of BTRY 601. Emphasis is on the use of multiple regression analysis,

analysis of variance, and related techniques to analyze data in a variety of situations. Topics include an introduction to data collection techniques; least squares estimation; multiple regression; model selection techniques; detection of influential points, goodness-of-fit criteria; principles of experimental design; analysis of variance for a number of designs, including multi-way factorial, nested, and split plot designs; comparing two or more regression lines; and analysis of covariance. Emphasis is on appropriate design of studies prior to data collection, and the appropriate application and interpretation of statistical techniques. For practical applications, computing is done with the MINITAB and SAS statistical packages.

#### **BTRY 603 Statistical Methods III**

Fall or spring. 3 credits. Prerequisite: BTRY 601 and 602 or permission of instructor. Offered alternate years. Not offered 1997-98; offered Spring 1997.

Categorical data analysis, including logistic regression, loglinear models, stratified tables, matched pairs analysis, polytomous response and ordinal data. Applications in biomedical and social sciences.

#### **[BTRY 604 Statistical Methods IV: Applied Design]**

Fall or spring. 3 credits. Prerequisites: BTRY 601 and 602 or permission of instructor. Offered alternate years. Not offered 1996-97; next offered fall 1997.

Applications of experimental design including such advanced designs as split plots, incomplete blocks, fractional factorials. Use of the computer for both design and analysis will be stressed, with emphasis on solutions of real data problems.]

#### **[BTRY 606 Sampling Biological Populations]**

Fall, 1/3 of the term. 1 credit. Prerequisite: BTRY 601 or equivalent. Offered alternate years. Not offered 1996-97.

Standard methods of sample-survey design and estimation are presented, including stratified random sampling, cluster sampling, double sampling, and variable probability sampling. Special emphasis given to methods of particular utility or specifically designed for biological sampling. Examples are taken from forestry, fisheries, and other biological areas.]

#### **[BTRY 607 Nonparametric and Distribution-Free Statistical Methods]**

Spring, 1/3 of the term. 1 credit. S-U grades optional. Prerequisite: BTRY 601 or equivalent. Offered alternate years. Not offered 1996-97.

Nonparametric and distribution-free alternatives to normal-theory testing procedures are presented: sign or rank tests for one or two populations; analyses for completely randomized and randomized blocks designs; comparisons among several means; correlation and regression; goodness-of-fit; and tests based on randomization of the data.]

#### **BTRY 639 Epidemiology Seminar**

Spring. 1 credit, variable. S-U grades only. Permission of instructor.

This course will develop skills in the preparation and interpretation of epidemiological data by discussing current research topics and issues.

#### **BTRY 662 Mathematical Ecology**

Fall. 3 credits. S-U grades optional.

Prerequisites: a year of calculus and a course in statistics.

Mathematical and statistical analysis of populations and communities: theory and methods. Spatial and temporal pattern analysis, deterministic and stochastic models of population dynamics. Model formulation, parameter estimation, and simulation and analytical techniques.

#### **BTRY 672 Topics in Environmental Statistics (also OR&IE 672)**

Fall and spring. 2 credits. S-U grades optional. Prerequisite: BTRY 601 or permission of the instructor.

This course is a discussion group focusing on statistical problems arising in the environmental sciences. These issues are explored in a number of different ways, such as student presentations of research papers, directed readings, and outside speakers.

#### **BTRY 682 Statistical Methods for Molecular Biology**

Spring. 2 credits. S-U only. Prerequisite: Permission of instructor.

Statistical and mathematical topics of current interest in molecular biology: genetic mapping, physical mapping, DNA sequence analysis, phylogenetic inference, population modeling. Topics may vary. The course may be repeated for credit.

#### **BTRY 694 Graduate Special Topics in Biometry and Statistics**

Fall or spring. 1-3 credits. S-U grades optional.

A course of lectures selected by the faculty. Because topics usually change from year to year, this course may be repeated for credit.

#### **BTRY 697 Individual Graduate Study in Biometry and Statistics**

Fall, spring, or summer. 1-3 credits. S-U grades optional.

Consists of individual tutorial study selected by the faculty. Since topics usually change from year to year, this course may be repeated for credit.

#### **[BTRY 717 Linear Models]**

Spring. 3 credits. S-U grades only. Prerequisites: BTRY 409 or equivalent and BTRY 417 and 602. Offered alternate years. Not offered 1996-97.

Analysis of variance and estimation procedures for unequal-subclass-numbers data. Cell means models for the 1-way classification, nested classifications, and the 2-way crossed classification, both with and without interactions; introduction to multinomial variables and the distribution of quadratic forms. The general linear model (in matrix and vector form), estimable functions, and testable hypotheses. Overparameterized models, restricted models, multifactor cases, covariables, computing.]

#### **[BTRY 718 Variance Components]**

Spring. 3 credits. S-U grades only. Prerequisite: BTRY 717. Offered alternate years. Not offered 1996-97.

Several methods of estimating variance components are explained and compared: for balanced data (equal subclass numbers), the analysis of variance method; for unbalanced data (unequal subclass numbers), the three Henderson methods and the methods of maximum likelihood, restricted maximum likelihood, and minimum norm quadratic unbiasedness. Also included: estimation from

mixed models, prediction of random variables, the dispersion-mean model, and computer package output for variance component estimation.]

#### **BTRY 795 Statistical Consulting**

Fall and spring. 2 credits. S-U grades only. Limited to graduate students.

Participation in the Biometrics Unit consulting service: faculty supervised statistical consulting with researchers from other disciplines. Discussion sessions for joint consideration of selected consultations encountered by the services during previous weeks. Since consultations usually change from semester to semester, the course may be repeated for credit.

#### **BTRY 800 Master's Level Thesis Research**

Fall or spring. Credit to be arranged. S-U grades only. Limited to candidates for graduate degrees. Prerequisite: permission of the graduate field member concerned.

Research at the M.S. level.

#### **BTRY 900 Graduate Level Dissertation Research**

Fall or spring. Credit to be arranged. S-U grades only. Limited to candidates for graduate degrees. Prerequisite: permission of the graduate field member concerned.

Research at the Ph.D. level.

#### **BTRY 901 Doctoral Level Dissertation Research**

Fall or spring. Credit to be arranged. S-U grades only.

## COMMUNICATION

C. J. Glynn, chair; R. D. Colle, L. Cowdery, K. Druckman, B. O. Earle, G. Gay, D. A. Grossman, M. Korcok, B. Lewenstein, A. Marshall, D. G. McDonald, R. E. Ostman, T. M. Russo, C. Scherer, D. F. Schwartz, J. Shanahan, M. A. Shapiro, P. Stepp, R. B. Thompson, M. Toor, L. VanBuskirk, W. B. Ward, S. A. White, J. P. Yarbrough

**Note: class meeting times are accurate at the time of publication. If changes are necessary, the department will provide new information as soon as possible.**

#### **COMM 116 Communication in Social Relationships**

Spring or summer. 3 credits. Not open to first-semester freshmen. Spring: lec, M W F 1:25-2:15. Staff.

An overview of current knowledge about communication, with particular emphasis on interpersonal communication. Introduction to a wide range of contemporary theories and research about effective communication in contexts such as friendships, small groups, organizations, and health care settings.

#### **COMM 117 Writing About Communication**

Spring. 3 credits. Concurrent enrollment in Comm 116 required. TR 10:10-11:25. L. VanBuskirk and staff.

Students develop skill in various writing styles and genres. The class explores communication practices and theories as they are observed and studied in personal and professional contexts. Assignments polish students' ability to gather information, to analyze information, to integrate ideas about

communication, and to express those ideas clearly and cogently.

### **COMM 120 Contemporary Mass Communication**

Fall. Lec, M W 12:20–1:10; disc, R 10:10–11:00, 11:15–12:05 or 1:25–2:15 or F 10:10–11:00, or 12:20–1:10. J. Shanahan.

The processes and effects of communication systems. Topics include the evolution of communication media, current knowledge about mediated communication, and the role of communication in contemporary social issues. Discussion sections relate the course topics to students' personal experience. Assignments include case studies, experiential learning exercises, and short papers.

### **COMM 121 Investigating Communication**

Fall. 3 credits. Students must be enrolled concurrently in COMM 120. Lec, T R 8:40–9:55, 10:10–11:25, 11:40–12:55 or 1:25–2:40. R. Ostman.

An examination of research methods in communication, with particular emphasis on the mass communication process. Exercises in writing, speaking, and working in small groups focus on topics such as gender depictions, violence in the media, and social roles.

### **COMM 191 Topics in Communication**

Summer. 1–3 credits. Hours to be arranged. Staff.

Study of topics in communication at lower-division level. Special emphasis on topics reflecting the expertise of visiting faculty available in summer session and on topics suitable for entry-level college students.

### **COMM 201 Oral Communication**

Fall, spring, or summer. 3 credits. Each section limited to 20 students (fall and spring) or 15 students (summer). Preference given to sophomores, juniors, and seniors. Fluency in spoken English is assumed. Students missing the first two class meetings without university excuse are dropped so others may register. No student will be added or dropped after the second week of classes. B. Earle, M. Kocok, T. Russo, R. Thompson, and staff.

Through theory and practice students develop self-confidence and competence in researching, organizing, and presenting material to audiences. Students give four graded speeches, write short papers, perform speaker evaluations, and engage in other speech-related activities.

### **COMM 203 Argumentation and Debate**

Fall. 3 credits. T R 10:10–11:25. P. Stepp. The student will learn the principles of argumentation and the rules of debate. Classroom debates on the CEDA national topic will provide experience in critical thinking, rapid organization of thoughts, employment of research, and writing and speaking in a logical, persuasive manner.

### **COMM 204 Effective Listening**

Fall and spring. 3 credits. Limited to 25 nonfreshman students per section. No students accepted or allowed to drop after the second week of classes. Lec, M 2:55–4:10; sec, W 1:25–2:40, 2:55–4:10; R 1:25–2:40, 2:55–4:10. R. Thompson.

Lecture and sections are used to present an analysis of the process of listening, to identify barriers to effective listening, and to develop students' listening skills. Topics include audiology, cultural contexts, intercultural

communication, linguistics, therapeutic listening, and critical analysis of information. Students are involved in skill-building exercises and in writing self-analytical papers, as well as attending seminars.

### **COMM 230 Visual Communication**

Fall. 3 credits. Lec, T R 9:05–9:55; lab, T 2:30–4:25; W 10:10–12:05, 12:20–2:15 or 2:30–4:25. C. Scherer.

An introduction to visual communication theory. Course examines how visuals influence our attention, perspectives, and understanding. Examples of visuals drawn from advertising, TV news, documentaries, entertainment movies, print and interactive media are used to develop a theoretical framework for becoming more visually aware and for thinking more critically about how visuals influence us.

### **COMM 232 Art of Publication**

Fall and spring. 3 credits. Each lab limited to 24 nonfreshman students. Students missing the first two classes without university excuse are dropped so others may register. Project materials cost \$75–\$100. Lec, M W 10:10–11:00 or 11:15–12:05; labs M 2:30–4:25; W 2:30–4:25. M. Toor.

A basic course designed to explore visual concepts that increase communication effectiveness through the printed word. The importance of selecting and coordinating format, layout, typography, and illustrations is stressed. Lectures, in-class laboratory assignments, and outside projects examine opportunities and problems in publication design and desktop publishing.

### **COMM 250 Newswriting for Newspapers**

Fall, spring, or summer. 3 credits. Limited to 25 students. Prerequisite: Major in communication, or permission of instructor. Keyboarding ability essential. Students missing first two classes without university excuse will be dropped. Lec, M W 9:05–9:55; labs, R 2:30–4:25 or F 9:05–11:00. Staff.

Writing and analyzing news stories. A study of the elements that make news, sources of news, interviewing, writing style and structure, press problems, and press-society relations. Concentration on newswriting as it is practiced by newspapers in the United States. Two writing assignments each week, one done in class, one done out of class.

### **COMM 272 Principles of Public Relations and Advertising**

Summer. 3 credits. Not open to freshmen. Staff.

Survey of the fields of public relations and advertising. Descriptions of organizations, jobs, and functions in the industry. The roles of public relations and advertising in society, the economic system, and organizations. Psychological and sociological principles as bases for appeals. Strategies for media selection and message execution. Introduction to research and regulation.

### **COMM 273 Communication Institutions**

Spring. 3 credits. Letter only. T R 11:40–12:55. J. Shanahan.

A survey of the history, organization, and social importance of communication institutions. Institutions to be analyzed include advertising/PR, media industries, propaganda and political communication, news/journalism, and new technologies. Cases and examples will be drawn from areas relevant to CALS

programs, including environment, agricultural policy and land use. Communication 116 or 120 are suggested but not required.

### **COMM 280 Thinking about Communication**

Spring. 3 credits. Prerequisite: COMM 116, 120, and at least one writing or oral communication course. Communication majors only. Not open to freshmen. Communication sophomores given priority. Lec 01, T R 11:40–12:55; Lec 02, T R 10:10–11:25; Lec 03, M W 8:40–9:55. R. Ostman and staff.

Expanding upon conceptual knowledge gained in introductory communication courses, students will learn critical thinking in the context of communication topics, issues, problems, and questions selected annually by individual instructors. After learning, discussing, and practicing critical thinking, students will have an enhanced ability to create and sustain responsible dialogue, as well as to evaluate implications and applications of thought.

### **COMM 284 Sex, Gender, and Communication**

Fall. 3 credits. Not open to freshmen. T R 2:55–4:10. L. Van Buskirk.

The course explores the personal, career, social, and economic implications of gender categories. Topics considered include theories of gender construction, social structures, personal relationships, and gender concerns in the workplace.

### **COMM 285 Communication in Life Sciences**

Spring. 3 credits. M W 2:55–4:10. B. Lewenstein.

Environmental problems...public health issues...scientific research. In each of these areas, communication plays a fundamental role. From the mass media to individual conversations, from technical journals to textbooks, from lab notes to the World Wide Web, communication helps define social issues and research findings. This course examines the institutional and intellectual contexts, processes, and practical constraints on communication in the life sciences.

### **COMM 301 Business and Professional Speaking**

Fall, spring, or summer. 3 credits. Prerequisite: COMM 201. Limited to second term sophomores, juniors and seniors during fall and spring. Lec, M W 11:15–12:05; sec, T 2:30–4:25; W 12:20–2:15; R 10:10–12:05. B. Earle.

The study and practice of written and oral communication skills used in formal and informal organizations, including interviews, informative and persuasive speeches, reports, and discussions. Students exercise and enhance the organizational, analytical, and presentational skills needed in particular settings suited to their own business and professional careers.

### **COMM 303 Speech and Debate Practicum**

Fall and spring. 2 credits. Limited to 10–15 Program in Speech and Debate members only; permission of instructor and completion of one-year trial basis. Hours to be arranged. P. Stepp.

Students will learn preparation for practice in CEDA (Cross Examination Debate Association) debate, Lincoln Douglas debate, or individual speaking events. The class will be divided

into four groups according to level of experience; therefore it may be repeated to a maximum of 8 credits.

### COMM 315 Introduction to Health Communication

Fall. 3 credits. COMM 116 or COMM 120 or permission of instructor. Juniors and seniors only. T R 1:25-2:40. A. Marshall.

An overview of health communication, examining topics such as physician-patient relationships, the role of support groups, communication in health care organizations, cultural differences in health beliefs and communication, and public health campaigns. Instruction techniques include class discussion, presentations, and group projects.

### COMM 342 Electronic Media

Spring or summer. 3 credits. Limited to 21 communication majors. Prerequisite: COMM 120. Lec, T R 1:25-2:40. T. Russo. The process of audio and video message design and production is explored. Emphasis is on development of skills needed for the creation of effective audio/video production. Students complete exercises designed to develop specific competencies and work on productions from conception through completion.

### COMM 348 Video as a Communication Tool

Fall. 3 credits. Prerequisites: permission of instructor. Lec, T R 10:10-11:00; lab, R 1:25-4:25. S. White. This course explores video as a non-broadcast communication tool utilizing organizational and visual communication conceptual and theoretical foundations. An overview of video applications, visual thinking, and team building in employing participatory approaches to constructing messages. Covers basics of interactive media and issues of changing communication technologies. Hands-on team project integrates knowledge, theory, and practice. Students have access to camcorders and editing equipment.

### COMM 350 Writing for Magazines

Fall or spring. 3 credits. Limited to 25 juniors, seniors, and graduate students, or others with permission of instructor. No drops after third week. Extensive out-of-class writing assignments. Fall: M 1:25-4:25; spring: T R 12:20-1:50. W. Ward and staff.

A course in nonfiction freelance writing for magazines. Intensive fact writing to help students communicate more effectively through the medium of the printed word in magazines. Art and techniques of good writing are studied; magazines in many fields of interest are reviewed. All articles are analyzed and returned to the student to rewrite and submit to a magazine.

### COMM 352 Science Writing for the Mass Media

Fall. 3 credits. Not open to freshmen. Prerequisite: one college-level writing course. Lec, M W 9:05; lab, W 12:20-2:15, 2:30-4:25. B. Lewenstein.

How to write about science, technology, and medicine for the mass media. Discussion topics include accuracy, simplicity, comprehensiveness, risk communication, and the history and social structure of science. Writing assignments focus on writing news and feature stories for newspapers and magazines, with excursions into newsletters, radio, TV, and other media.

### COMM 360 Scientific Writing for Public Information

Fall and spring. 3 credits. Limited to 25 nonfreshman or graduate students per section. Prerequisite: one college-level writing course. Fall: Lec 01, M W F 9:05-9:55. Spring: Lec 01, M W F 9:05-9:55. Lec 02, M W F 10:10-11:00. L. Cowdery.

An intensive course in simplifying scientific and technical material for specific audiences within the general public. Weekly assignments include instructions, descriptions, explanations, and summaries in such formats as the newsletter, brochure, and report. Audience analysis will be emphasized. Not oriented to the mass media, or writing for scientists.

### COMM 363 Organizational Writing

Fall, spring, or summer. 3 credits. Limited to 25 junior, senior, or graduate students per section. Prerequisite: any college-level writing course. Lec 01, M F 11:15-12:05; Sec M 12:20-2:15; W 10:10-12:05. L. Van Buskirk and staff.

Students write as members of different organizations, in the position of supervisor, subordinate, colleague, and representative of business, government, community, and other organizations. Emphasis on adapting tone to the audience and the purpose of the message. Weekly writing assignments include various kinds of internal and external reports, memoranda, proposals, and letters. Assignments based on the Exxon Valdez oil spill and other case studies.

### COMM 368 Editing

Fall. 3 credits. Limited to 25 junior, senior, or graduate students. Prerequisite: COMM 250, 350, 352, or 360. M W F 12:20-1:10. L. Cowdery.

Students will follow the process that takes a manuscript from final draft to publication. Emphasis will be on copy editing, proofreading, fitting copy, working with authors, making editorial decisions, and developing skill in critical reading. Appropriate for any student who expects to work with manuscripts or do editorial work.

### COMM 376 Planning Communication Campaigns

Spring. 3 credits. Limited to 20 juniors and seniors. Prerequisite: COMM 116 or 120 or permission of instructor. T R 10:10-11:25. Staff.

Overviews theories that guide and influence social change efforts. Research techniques and communication tools used in communication planning and campaign design are reviewed. Class discussion focuses on social change efforts in nutrition and health, rural development, marketing, and the environment. Students work closely with a client in designing a communication campaign.

### COMM 380 Independent Honors Research in Social Science

Fall or spring. 1-6 credits. Limited to undergraduates who have met the requirements for the honors program. B. Lewenstein.

### COMM 382 Methods of Communication Research

Spring. 3 credits. Lec M W 12:20-1:10; labs, F 10:10-12:05 or 12:20-2:15. J. Shanahan.

An analysis of the methods used in communication research. Emphasis on understanding the rationale for survey, textual, experimental,

and ethnographic research methods. Development of class research project from research question to final report. Computer use of Statistical Package for the Social Sciences (SPSS) to assist in data analysis. Familiarity with basic statistical concepts helpful.

### COMM 405 Community Service Practicum

Fall and spring. 2 credits. May be repeated for credit. Limited to 10-15 Program in Speech and Debate members; permission of instructor required. Hours to be arranged. P. Stepp.

Students share their communication talents in structured experiences in which they design and implement a speech or debate project in local schools or the community.

### COMM 410 Organizational Behavior and Communication

Fall. 3 credits. Labs limited to 15 junior, senior, or graduate students. Prerequisite: COMM 116 or equivalent. Lec, M W 11:15-12:05; Sec 01, W 2:30-4:25; Sec 02, F 10:10-12:05. D. Schwartz.

Study of management and leadership in formal organizations with emphasis on the psychology of communication between supervisor and employee; examination of formal and informal communication networks, and interpersonal communication in an organizational context. Case studies analyzed in lab. Lectures concurrent with COMM 510; graduate students should enroll in COMM 510.

### COMM 411 Leadership from a Communication Perspective

Fall. 3 credits. Limited to 30 students. Lec, T R 1:25-2:40. P. Stepp.

Leadership is a product of human communication. Leadership competence can be increased by increasing communication competence. Leadership theories, particularly transformational leadership will be studied, and gender/minority responsive leadership will be stressed. Practical application will include leadership exercises and observation of leaders.

### COMM 418 Communication and Persuasion

Spring. 3 credits. Prerequisite: COMM 116 and 120 or introductory psychology or social psychology. M W 2:55-4:10 (one evening mid-semester prelim). M. Shapiro.

The course focuses on theories of communication influence on persuasion and attitude change. Students will become familiar with a variety of social-psychological theories of attitude change and persuasion. Those theories also will be applied to a variety of communication situations including mass communication, advertising, public relations/public information, and interpersonal communication. Lectures concurrent with COMM 618; graduate students should enroll in COMM 618.

### COMM 420 Public Opinion and Social Processes

Fall. 3 credits. Lec, T R 10:10-11:25. C. Glynn.

The course provides an overview of the theoretical and applied literature related to the concept "public opinion." Students investigate how public opinion is perceived and acted upon by society. Relationships between public opinion, communication and social psychological variables are examined. Public opinion is studied using current theoretical and practical applications. Analysis and



interpretation of public opinion polls and trends in public opinion on specific issues. Lectures concurrent with COMM 620; graduate students should enroll in COMM 620.

**COMM 421 Communication and the Environment**

Spring. 3 credits. Limited to 20 junior, senior, or graduate students or permission of the instructor. Lec, T R 2:55-4:10. J. Shanahan.

Students will investigate how values, attitudes, social structure, and communication affect public perceptions of environmental risk and public opinion about the environment. A primary focus will be mass media's impact in public perceptions of the environment, how the media portray the environment, and discussion of the implications of public consumption of environmental content.

**COMM 422 Psychology of Television**

Fall. 3 credits. Prerequisites: Introductory psychology and COMM 120. M W F 12:20-1:10 (one evening mid semester prelim). M. Shapiro.

A survey of knowledge about the psychological influence of television and other audio-visual communication technologies. Topics may include: the history of concerns about television and movies, who watches television and why, how people understand and mentally process television, how television influences thinking and emotions, the effects of various forms (including entertainment, news, and advertising), the future forms of mass media including multimedia and virtual reality. Lectures concurrent with COMM 622; graduate students should enroll in COMM 622.

**[COMM 424 Communication in the Developing Nations]**

Spring. 3 credits. Limited to juniors and seniors. T R 2:55-4:10. Not offered 1996-97. R. Colle.

The role of communication in development programs, particularly in Third World. Emphasis is on communication interventions in agriculture, health, nutrition, family planning and community development, and especially on methods for designing communication strategies for reaching low-income, rural people. Among the approaches considered are extension, social marketing, and development support communication. Lectures concurrent with COMM 624; graduate students should enroll in COMM 624.]

**COMM 426 Impact of Communication Technologies**

Fall. 3 credits. M W 2:55-4:10. P. Yarbrough.

Examine emerging technologies of communication, such as computer-based information systems and satellites and their potential for influencing communication processes and social systems. Also examines the impacts of previous communication innovations from cave painting to television. Lectures concurrent with COMM 626; graduate students should enroll in COMM 626.

**COMM 428 Communication Law**

Spring. 3 credits. Limited to junior, senior, and graduate students; others by permission of the instructor. Lec, M W F 11:15-12:05. D. Grossman.

A practical survey of the law governing mass media, primarily for those working in the field. Coverage includes restraints on news gathering and publication, privacy, defamation, copyright, broadcast and cable regula-

tion, access, electronic media and other issues of current interest.

**COMM 439 Interactive Multimedia: Design and Research Issues**

Fall. 3 credits. Prerequisite: permission of instructor. Lec, T R 11:15-12:05; lab T 12:20-2:15. G. Gay.

An overview of interactive multimedia technologies (videodisc, CD-ROM, digital video technologies, computer graphics, and text). Course will focus on theories and research applicable to interactive multimedia such as visualization, learner control, mental models, knowledge representations, and information processing. Course will also emphasize interactive multimedia design, application, and evaluation.

**COMM 440 Social Design of Communications Systems**

Spring. 3 credits. Permission of instructor. S-U grades optional. Lec, T R 11:15-12:05; lab, T 12:20-2:15. G. Gay.

Course will focus on the design of computer interfaces and software from the user's point of view. The goal is to teach user interface designs that "serve human needs" while building feelings of competence, confidence, and satisfaction. Topics include formal models of people and interactions, collaborative design issues, psychological and philosophical design considerations, and cultural and social issues.

**COMM 460 Video Communication I: Basic Concepts and Theory, Planning, and Participatory Production**

Summer only. 2 credits. Fee: \$50.00. T R 9:00-4:00. S. White and staff.

The course focuses on understanding video as a tool in development communication. Hands-on instruction covers use of the video portapak and editing systems. Participants produce videotapes emphasizing the power of images, video for individual feedback, group process observation, and process intervention for individual and community development.

**COMM 461 Video Communication II: Video for Development/Social Intervention**

Summer only. 3 credits. Prerequisites: COMM 460 and/or permission of instructor. M W F 10:10-1:00. S. White and staff.

Explores the use of video in the context of development. Covers advanced visualization concepts and techniques and issues relevant to appropriate application of video technologies. Participants develop and implement proposals for creating a videotape designed to meet specific communication objectives.

**COMM 466 Public Communication of Science and Technology**

Fall. 3 credits. Limited to 15 students. Prerequisite: COMM 352 or 360, or Engineering 350, or permission of instructor. M W 2:55-4:10. B. Lewenstein.

Explore the structure, meanings, and implications of "public communication of science and technology" (PCST). Examine the contexts in which PCST occurs, look at motivations and constraints of those involved in producing information about science for nonprofessional audiences, analyze the functions of PCST. Tie existing ideas about PCST to general communication research, and learn how to develop new knowledge about PCST. Course format is primarily seminar/discussion.

**COMM 486 Risk Communication**

Spring. 3 credits. T R 1:25-2:40. C. Scherer.

An examination of theory and research related to the communication of scientific information about environmental, agricultural, food, health, and nutritional risks. Course will concentrate on social theories related to risk perception and behavior. Case studies involving pesticide residues, waste management, water quality, environmental hazards, and personal health behaviors will be examined. Emphasis will be placed on understanding, applying, and developing theories of risk communication. Lectures concurrent with COMM 686; graduate students should enroll in COMM 686.

**COMM 487 Communication, Mood, and Emotion**

Fall. 3 credits. Prerequisites: COMM 382 or equivalent. M W F 1:25-2:15. D. McDonald.

An examination of theory and research on communication and emotion. The course consists of the following seven areas: defining mood and emotion, tactics for investigation, emotion and cognition, mood and emotion as communication effects, communication as consequence, communication and mood management, and enduring issues.

**COMM 494 Special Topics in Communication**

Fall, spring, or summer. 1-3 credits variable. S-U grades optional. Prerequisite: permission of instructor.

Study of topics in communication not otherwise provided by a department course and determined by the interest of the faculty and students.

**COMM 496 Internship**

Fall, spring, summer, and intersession. 1-3 credits. Students must apply no later than the spring pre-course enrollment period for a fall internship or the fall pre-course enrollment period for a spring or summer internship. Prerequisites: Limited to communication juniors or seniors, 3.0 average in communication courses, and approval of academic advisor. S-U grades only.

Structured, on-the-job learning experience under supervision of communication professionals in a cooperating organization. Maximum of 6 credits total may be earned; no more than 3 per internship but flexibility allows 6 for 1 credit each, 3 for 2 credits each, or 2 for 3 credits each. Internships must be approved in advance by the student's academic advisor and must be supervised by a communication professional in fields of public relations, advertising, publishing, or broadcasting. Minimum of 60 on-the-job hours per credit required.

**COMM 497 Individual Study in Communication**

Fall or spring. 1-3 credits; may be repeated to 6 credits with a different supervising faculty member. Prerequisite: 3.0 cumulative average. Students must register with an Independent Study form (available in 140 Roberts Hall).

Group or individual study under faculty supervision. Work should concentrate on locating, assimilating, synthesizing, and reporting existing knowledge on a selected topic. Attempts to implement this knowledge in a practical application are desirable.

**COMM 498 Communication Teaching Experience**

Fall or spring. 1-3 credits; may be repeated to 6 credits with different courses. Limited to juniors and seniors. Intended for undergraduates desiring classroom teaching experience. Prerequisite: 3.0 cumulative average (2.7 if teaching assistant for a skill development course) and permission of the faculty member who will supervise the work and assign the grade. Students must register with an Independent Study form (available in 140 Roberts Hall).

Periodic meetings with the instructor cover realization of course objectives, evaluation of teaching methods, and student feedback. In addition to aiding with the actual instruction, each student prepares a paper on some aspect of the course.

**COMM 499 Independent Research**

Fall or spring. 1-3 credits; may be repeated to 6 credits. Limited to seniors and graduate students. Prerequisite: 3.0 cumulative average. Students must register with an Independent Study form (available in 140 Roberts Hall).

Permits outstanding students to conduct laboratory or field research in communication under appropriate faculty supervision. The research should be scientific: systematic, controlled, empirical. Research goals should include description, prediction, explanation, or policy orientation and should generate new knowledge.

**[COMM 510 Organizational Behavior and Communication]**

Fall. 3 credits. Not offered 1996-97. Study of management and leadership in formal organizations with emphasis on the psychology of communication between supervisor and employee; examination of formal and informal communication networks, and interpersonal communication in an organizational context. Case studies analyzed in lab. Lectures concurrent with COMM 410; graduate students should enroll in COMM 510.]

**COMM 610 Seminar in Organizational Communication**

Spring. 3 credits. Prerequisites: COMM 410/510 or one course in organizational behavior or permission of instructor. Lec, M W 11:15-12:05; lab, F 10:10-12:05. D. Schwartz.

Examination of contemporary research on the social psychology of interpersonal communication in organizations including supervisor-employee relations, leadership style, work motivation, organizational socialization, and formal and informal communication networks.

**COMM 618 Communication and Persuasion**

Spring. 3 credits. Prerequisite: introductory psychology or social psychology or introductory research methods course. M W 2:55-4:10. M. Shapiro.

The course focuses on theories of communication influence on persuasion and attitude change. Students will become familiar with a variety of social-psychological theories of attitude change and persuasion. Those theories also will be applied to a variety of communication situations including mass communication, advertising, public relations/public information, and interpersonal communication. Lectures concurrent with

COMM 418; graduate students should enroll in COMM 618.

**COMM 620 Public Opinion and Social Processes**

Fall. 3 credits. T R 10:10-11:25. C. Glynn. The course provides an overview of the theoretical and applied literature related to the concept "public opinion." Students investigate how public opinion is perceived and acted upon by society. Relationships between public opinion, communication and social psychological variables are examined. Public opinion is studied using current theoretical and practical applications. Analysis and interpretation of public opinion polls and trends in public opinion on specific issues. Lectures concurrent with COMM 420; graduate students should enroll in COMM 620.

**COMM 622 Psychology of Television**

Fall. 3 credits. Prerequisites: introductory psychology or social psychology and introductory research-methods course. M W F 12:20-1:10. M. Shapiro.

A survey of knowledge about the psychological influence of television and other audiovisual communication technologies. Topics may include: the history of concerns about television and movies, who watches television and why, how people understand and mentally process television, how television influences thinking and emotions, the effects of various forms (including entertainment, news, and advertising), the future forms of mass media including multimedia and virtual reality. Lectures concurrent with COMM 422; graduate students should enroll in COMM 622.

**[COMM 624 Communication in the Developing Nations]**

Spring. 3 credits. Open to juniors, seniors, and graduate students. T R 2:55-4:10. Not offered 1996-97. R. D. Colle. The role of communication in development programs, particularly in Third World nations. Emphasis is on communication interventions in agriculture, health, nutrition, family planning and community development, and especially on methods for designing communication strategies for reaching low-income, rural people. Among the approaches considered are extension, social marketing, and development support communication. Lectures concurrent with COMM 424; graduate students should enroll in COMM 624.]

**COMM 625 Communication for Social Change**

Summer only. 3 credits. T R 9:00-1:00. Staff.

A survey of international communication problems and perspectives on social change, with a special focus on the Third World. Concentration on critical issues of communication policy and planning at local, national, and international levels, and the impact of new communication technologies.

**COMM 626 Impact of Communication Technologies**

Fall. 3 credits. Open to seniors. M W 2:55-4:10. P. Yarbrough. Examines emerging technologies of communication, such as computer-based information systems and satellites and their potential for influencing communication processes and social systems. Also examines the impacts of previous communication innovations from cave painting to television. Lectures concurrent with COMM 426; graduate students enroll in COMM 626.

**COMM 639 Interactive Multimedia: Design and Research Issues**

Fall. 3 credits. Prerequisite: permission of instructor. Lec, T R 11:15-12:05; lab, T 12:20-2:15. G. Gay.

An overview of multimedia technologies (videodisk, CD-ROM, digital video technologies, computer graphics, and text). Course will focus on theories and research applicable to interactive multimedia such as visualization, learner control, mental models, knowledge representations, and information processing. Course will also emphasize interactive multimedia design, application, and evaluation.

**COMM 640 Social Design of Communication Systems**

Spring. 3 credits. Prerequisite: permission of instructor. Lec, T R 11:15-12:05; lab, T 12:20-2:15. G. Gay.

Course will focus on the design of computer interfaces and software from the user's point of view. The goal is to teach user interface designs that "serve human needs" while building feelings of competence, confidence, and satisfaction. Topics include formal models of people and interactions, collaborative design issues, psychological and philosophical design considerations, and cultural and social issues.

**COMM 676 Planning Communication Campaigns**

Spring. 3 credits. T R 10:10-11:25. C. Scherer.

Overview theories that guide and influence social change efforts. Research techniques and communication tools used in communication planning and campaign techniques and communication tools used in communication planning and campaign design are reviewed. Class discussion focuses on social change efforts in nutrition and health, rural development, marketing, and the environment. Course seeks to integrate theory, data-based generalizations, and planning processes into an integrated communication plan.

**COMM 680 Studies in Communication**

Fall. 3 credits. Limited to graduate students in communication; others by permission of instructor. M W 9:05-11:00. D. McDonald.

A review of classical and contemporary readings in communication, including key concepts and areas of investigation. An exploration of the scope of the field, the interrelationships of its various branches, and an examination of the role of theory in the research process.

**[COMM 681 Seminar in Psychology of Communication]**

Spring. 3 credits. Prerequisite: graduate students in communication; others by permission of instructor. Not offered 1996-97. M. Shapiro.

An introduction to theory and research in the mental processes of the communicating individual. Discussions and readings may include how individuals process and remember communication information, how communication information is used in decision processes, how motivation influences processing of mass communication information, and how attitudes form and change.]

**COMM 682 Methods of Communication Research**

Spring. 3 credits. Lec, M W 12:20-1:10; sec, F 12:20-2:15. R. Ostman.

An analysis of the methods used in communication research. Emphasis on understanding the rationale for survey, textual, experimental, and ethnographic research methods. Development of class research project from research question to final report. Computer use of Statistical Package for the Social Sciences (SPSS) to assist in data analysis. Familiarity with basic statistical concepts helpful.

**COMM 683 Quantitative Research Methods in Communication**

Spring. 3 credits. Prerequisite: COMM 682 or equivalent. Lec, M W 10:10–11:00; Sec, M 1:25–2:40. D. McDonald.

Experience in quantitative research techniques. The course provides an introduction to inter- and multi-disciplinary research through examination of the procedures, techniques and assumptions associated with particular techniques of design and measurement, data collection, data preparation, data analysis, and hypothesis testing. Readings include a variety of fields and disciplines in the social and natural sciences.

**COMM 684 Qualitative Methods in Communication Research**

Spring. 3 credits. T R 10:10–11:25. B. Lewenstein.

This course explores the nature of communication research and the place of qualitative methods in that research. Through readings, discussions, and papers, students will examine the various techniques of qualitative research, gaining both an introduction to those methods and an appreciation of when those methods are appropriate for addressing particular issues in communication.

**[COMM 685 Training and Development: Theory and Practice (also International Agriculture 685 and EDUC 685)]**

Spring. 4 credits. S-U grades optional. Charge for materials, \$45. F 9:05–12:05; lab to be arranged. Not offered 1996–97. R. Colle, D. Deshler, and M. Ewert.

Analysis, design, conduct, administration, and evaluation of training programs for the development of human resources in small-farm agriculture, rural health and nutrition, literacy and nonformal education, and general community development. Design for scientists, administrators, educator-trainers, and social organizers in rural and agricultural development programs in the U.S. and abroad.]

**COMM 686 Risk Communication**

Spring. 3 credits. T R 1:25–2:40. C. Scherer.

An examination of theory and research related to the communication of scientific information about environmental, agricultural, food, health, and nutritional risks. Course will concentrate on social theories related to risk perception and behavior. Case studies involving pesticide residues, waste management, water quality, environmental hazards, and personal health behaviors will be examined. Emphasis will be placed on understanding, applying, and developing theories of risk communication. Lectures concurrent with COMM 486; graduate students should enroll in COMM 686.

**[COMM 687 Communication, Mood and Emotion]**

Fall. 3 credits. Prerequisites: COMM 382 or equivalent. Not offered 1996–97. D. McDonald.

An examination of theory and research on communication and emotion. The course consists of the following seven areas: defining mood and emotion, tactics for investigation, emotion and cognition, mood and emotion as communication effects, communication as consequence, communication and mood management, and enduring issues. Lectures concurrent with COMM 487; graduate students should enroll in COMM 687.]

**COMM 688 Participatory Communication for Research and Development**

Summer only. 3 credits. Prerequisites: Qualitative research or graduate-level communication course and/or permission of instructor. Lects, T R 1:00–5:00; disc, arranged 2 hours/week. S. White.

Conceptual framework and theoretic rationale for utilizing participatory approaches in communication and research for rural development and social action. Case examples and video documentation from India, Africa, Latin America. Focus is on problem-solving approaches in communication and use of video as a communication tool for enhancing people's participation in the development context.

**COMM 691 Seminar: Topics in Communication**

Fall and spring. No credit. S-U grades only. Hours to be arranged. Staff.

Some weeks scholars from a wide variety of fields will present varied topics in theory or research as it relates to communication; other weeks graduate students will present thesis (project) proposals to faculty and peers.

**COMM 694 Special Topics in Communication**

Fall, spring, or summer. 1–3 credits variable. S-U grades optional. Prerequisite: permission of instructor. Hours to be arranged. Staff.

Study of topics in communication not otherwise provided by a department course and determined by the interest of the faculty and students.

**COMM 700 MPS Project Research**

Fall or spring. 1–6 credits. May be repeated for a maximum of 6 credits. Prerequisite: permission of committee chair.

Project research for Master of Professional Studies (Communication) students.

**COMM 794 Seminar in Communication Issues**

Fall, spring, or summer. 1–3 credits. Prerequisite: permission of instructor.

Small group study of topical issue(s) in communication not otherwise examined in a graduate field course.

**COMM 797 Graduate Independent Study**

Fall, spring, or summer. 1–3 credits. Prerequisite: permission of instructor.

Individual study concentrating on locating, assimilating, synthesizing, and reporting existing knowledge on a selected topic.

**COMM 798 Communication Teaching Laboratory**

Fall and spring. 1–3 credits each semester. May be repeated once. Limited to graduate students. Prerequisite: permission of the faculty member who will supervise the work and assign the grade. Students must use the faculty member's section number to register. Graduate faculty.

Designed primarily for graduate students who want experience in teaching communication courses. Students work with an instructor in developing course objectives and philosophy, planning, and teaching.

**COMM 799 Graduate Research**

Fall, spring, or summer. 1–3 credits. Prerequisite: appropriate communication graduate course work or permission of instructor.

Small-group or individual research based on original, empirical, data-based designs regarding topical issues in communication not otherwise examined in a graduate field course.

**COMM 800 Master's-Level Thesis Research**

Fall or spring. 1–6 credits. May be repeated for a maximum of 6 credits. Prerequisite: permission of committee chair.

Thesis research for Master of Science (Communication) students.

**COMM 901 Doctoral-Level Dissertation Research**

Fall or spring. 1–9 credits. May be repeated for a maximum of 9 credits. Prerequisites: completion of "A" exam; permission of committee chair. Dissertation research for doctoral candidates.

## EDUCATION

D. H. Monk, chair; W. S. Carlsen, J. Confrey, C. Conroy, J. D. Deshler, J. A. Dunn, D. M. Ewert, E. J. Haller, D. E. Hedlund, J. Millman, D. D. Peasley, S. C. Piliero, G. J. Posner, R. E. Ripple, V. N. Rockcastle, D. E. Schrader, R. E. Steele, K. A. Strike, H. D. Sutphin, D. J. Trumbull

**EDUC 005 Basic Review Mathematics**

Fall or spring. 3 credits (this credit is not counted toward the 120 credits required for the degree). Lects, M W F 8:00 or 9:05. S. C. Piliero.

Review of concepts necessary for success in EDUC 115 and basic statistics courses. Topics include problem solving, graphing, basic algebra skills, linear and quadratic functions, polynomial equations, exponents and logarithms, and right-triangle trigonometry. Considerable emphasis is placed on learning mathematics for understanding and on solving word problems.

**EDUC 101 Introduction to Education**

Fall. 3 credits. T R 11:40–12:55.

G. J. Posner and staff.

Education 101 explores three current issues in education in depth in order to introduce students to the field of education. The social-historical, psychological, and pedagogical foundations, and current proposals addressing each issue are considered.

**EDUC 115 Introductory College Mathematics**

Fall or spring. 4 credits. S. C. Piliero.

Designed for students wishing to fulfill distribution requirements and/or prepare for study in calculus. This course offers a nontraditional approach to college-level precalculus mathematics, stressing conceptual understanding, problem solving, and applications in a technology-enhanced environment. Considerable emphasis is placed on numerical, graphical and symbolic

representations of functions and their transformations. Students will use Function Probe®, multi-representational software for the Macintosh, in a collaborative, computer-based lab setting.

#### **EDUC 120 Education for Empowerment**

Spring. 1-3 credits. T R 2:30-4:00. Staff.  
A modular course, with each module spanning 5 weeks for 1 credit. Common themes running through the modules include human learning, teaching strategies, political/social/economic factors affecting education. The course provides an opportunity to sample different areas of study and to gain knowledge and awareness of one's own educational processes.

#### **EDUC 210 Psychology of Learning and Memory**

Fall. 3 credits. Prerequisite: introductory psychology. Not offered fall 1997.  
J. A. Dunn.  
This course deals with contemporary theories of learning, issues in the study of learning, and application of the principles of learning to the management of teaching and learning. Practical applications of research findings will be emphasized. One or more experimental projects and the use of microcomputers will be required.

#### **EDUC 212 Psychological Foundations of Education**

Spring. 2-3 credits. S-U option available. Prerequisite: introductory psychology.  
W 2-4:25 plus times to be arranged.  
J. A. Dunn.  
A lecture/discussion survey of the psychological foundations of educational practice. Topics include the selective contributions of developmental, social, and experimental psychology, including instructional technology, to American education.

#### **EDUC 240 The Art of Teaching**

Fall and spring. 3 credits. Fall: M 8-9:55 or T 10:10-12:05 or 2:30-4:25.  
D. J. Trumbull and staff. Spring: M 8-9:55 or 12:20-2:15 or T 2:30-4:25 or W 12:20-2:15 or 2:30-4:25. G. J. Posner and staff.  
This course is designed for all students interested in finding out more about teaching. Students engage in field experiences to find out what teaching involves. Possible field experiences range from large group to tutorial situations, from preschool to adult education, from traditional school subject matters to recreational and vocational areas, and from school-based to nonformal situations. Class work builds on those experiences and provides skills and concepts to make the field experiences more profitable.

#### **EDUC 247 Instructional/Informational Application of Microcomputers and Related Technologies**

Fall and spring. 2-3 credits. Not available to students who have completed ABEN 102 or NR 107. Lec, R 2:30-3:20; lab to be arranged. D. D. Peasley.  
The primary goal of the course is to develop conceptual understandings of instructional/informational applications of microcomputers and teach introductory to intermediate-level skills. Class instruction will relate to microcomputer and networked applications in both formal and informal educational/training settings. Independent study project required for third credit.

#### **EDUC 271 Sociology of Education**

Fall. 3 credits. S-U grades optional. T R 10:10-11:25. E. J. Haller.  
An introduction to the sociological study of schooling and education. Topics include the effects of social factors on educational achievement, the norms and values learned as part of the process of schooling, the relations between students and teachers, and the school's relations to the economic and political systems. All levels of education, from elementary school to the university, are considered.

#### **EDUC 311 Educational Psychology**

Fall. 3 credits. Prerequisite: introductory psychology. S-U grades optional. M W F 11:15-12:05. D. E. Schrader.  
This course applies psychological concepts to educational settings such as schools with a focus on understanding the interaction between people, context and knowledge in schools and other learning environments. It examines education as a social, moral, and interpersonal enterprise that respects differences between individuals. This course is designed to foster effective teaching and learning across the life span, but with a focus on secondary education.

#### **[EDUC 312 Learning to Learn**

Spring. 3 credits. Prerequisite: one or more courses in psychology or educational psychology. T R 9:05. Not offered 1996-97. Staff.  
This course is intended for persons interested in the improvement of their learning strategies and the application of new ideas and methods to improve educational programs. Lectures and discussions are based on assigned readings and the contributions of class members. The major focus of the course is how and why concepts play a central role in human learning. Concept mapping and other strategies for educating will be used. Students will apply principles and methodologies in a project related to their interests.]

#### **EDUC 317 Psychology of Adolescence**

Spring. 3 credits. Prerequisite: introductory psychology. S-U grades optional. M W 11:15-12:05; Friday section to be arranged. D. E. Schrader.  
This course surveys the nature of adolescent cognitive, social, moral, and self-development. Theories of adolescence are examined in the context of real-life experiences of adolescents using case analysis as a methodological tool. Educational implications will be discussed for both formal and informal settings.

#### **EDUC 331 Careers in Agriculture, Extension, and Adult Education**

Fall. 1-3 credits. Letter grade only. M 2:00-4:25. J. D. Deshler and D. E. Foster.  
This course will offer modules in three areas of teaching: Adult Education, Cooperative Extension, and Agricultural Education. Each module will offer one hour of credit, and students may take one or more of the modules. The course will provide a historical perspective and an introduction to the organization and scope of programs for each module. Students will examine career opportunities and characteristics of the professions addressed by each module. Course activities include field observations and experiences during arranged times.

#### **EDUC 332 Instructional Methods in Formal and Non-formal Education**

Spring. 3 credits. W F 3:35-5:15. Staff.  
Selection, practice, and evaluation of methods in formal and non-formal education will be stressed. The course will focus on both general teaching strategies and methodology unique to teaching in schools and non-formal settings. Course activities include micro-teaching and field experience during arranged times.

#### **EDUC 335 Youth Organizations**

Spring. 3 credits. T R 10:10-11:00; lab to be arranged. Staff.  
The role of selected youth organizations in providing educational experiences for youth. Factors affecting membership, purposes, design, operation, and administration are surveyed, emphasizing the roles an adult volunteer leader may play. The course is designed to give students an in-depth, learning-by-doing experience of how youth organizations function. Field experience with a recognized youth organization is required.

#### **EDUC 352 Reading Statistics**

Fall. 1 credit. T 12:20-1:10. J. Millman.  
An introduction to statistical vocabulary and symbolism frequently used in reporting empirical research in education and other social sciences. Students are taught how to comprehend statistical terminology and results.

#### **EDUC 370 Issues in Educational Policy**

Spring. 3 credits. T R 10:10-11:30.  
K. A. Strike.  
An examination of selected policy issues in current education. Included are such topics as equality of educational opportunity; student, parent, and teacher rights; and educational politics. Issues are treated from legal, sociological, and economic perspectives. Meets group C requirements for College of Agriculture and Life Sciences.

#### **EDUC 378 Political Economy of Education**

Fall. 3 credits. S-U grades optional. T R 12:20-2:15. D. H. Monk and staff.  
A policy oriented examination of educational systems with an emphasis on political and economic perspectives. Attention will be paid to both external and internal aspects of educational activities. Specific topics will include the changing contributions of education to earnings, school-community relations, power within educational organizations, the impact of technology in the workplace and in classrooms, and the sources and impact of educational costs. A variety of education settings will be examined including higher education and non-formal education.

#### **EDUC 380 Independent Honors Research in Social Science**

Fall or spring. 1-6 credits. Limited to students who have met requirements for the honors program. S-U grades optional. A maximum of 6 credits may be earned in the honors program. Staff.

#### **EDUC 401 Our Physical Environment**

Fall. 3 credits. Prerequisite: permission of instructor. Charge for laboratory supplies, approximately \$7. T 1:25-4:25.  
V. N. Rockcastle.  
A practical, relatively nonmathematical study of some basic relationships and physical interactions in the environment, with emphasis on physics and earth science. Attention is paid to analysis for understanding



and techniques for teaching. An individual research project is included. Useful for teachers, environmental educators, and those for whom physical science seems difficult or uninviting.

#### **EDUC 402 Knowing and Learning in Science and Mathematics**

Fall. 4 credits. Prerequisite: enrollment in science and math certification program or permission of instructor. M W 2:30-4:00. D. J. Trumbull.

Students examine both current notions in the history and philosophy of science that explain how knowledge within a discipline develops and current theory and research that examines the individual's acquisition of knowledge. This material serves as a basis for students' individual research projects investigating neophytes' knowledge of science and mathematics concepts. All students enrolled must complete fieldwork. Fieldwork will comprise a minimum of three hours a week in an appropriate educational setting.

#### **EDUC 403 Observing and Teaching Science and Math**

Spring. 4 credits. Prerequisites: Enrollment in a Cornell teacher education program or permission of the instructor. W F 3:35-5:15. W. S. Carlsen.

Designed for prospective secondary teachers, this course provides a multiple-perspectives orientation to the culture of schools and the work of teaching science and mathematics. Students spend 6-8 hours each week observing in area schools. Students also plan and teach innovative lessons in the scheduled teaching laboratory. Readings and discussions concern models of instruction, teacher knowledge, educational equity and tracking, and classroom language.

#### **[EDUC 411 Introduction to Educational Measurement**

Fall. 3 credits. Not offered 1996-97. J. Millman.

Presents practices and theories of the measurement of human knowledge and performance. Students will be expected to acquire the practical skills of planning and constructing tests for a variety of purposes, interpreting and using test results, evaluating commercially available instruments, and the like. Students will also be expected to discuss intelligently a myriad of social, ethical, legal, and technical issues associated with educational testing. One course in statistics or concurrent registration in Education 352 is recommended but is not required.]

#### **EDUC 413 Psychology of Human Interaction**

Fall. 3 credits. Enrollment limited. Prerequisite: permission of instructor. Fee, \$5. T R 10:10-12:05. D. E. Hedlund.

Designed to develop skills for, and understanding of, effective interpersonal communication and interaction. Appropriate for students in the helping professions, education, and areas involving management of human resources.

#### **[EDUC 414 Counseling Psychology**

Spring. 4 credits. Limited to 30 students. Prerequisites: introductory psychology, social or personality psychology, and EDUC 413. T R 10:10-12:05. Not offered spring 1997; next offered spring 1998. D. E. Hedlund.

The processes of counseling are examined from various theoretical perspectives. Typical

adult counseling issues are examined, and implications are drawn for counseling strategies with an adult population, including psychological assessment, establishing therapeutic goals, intervention strategies, and evaluation of outcomes.]

#### **EDUC 420 Field Experience**

Fall or spring. 1-4 credits. S-U grades optional. Undergraduates must attach to their course enrollment material written permission from the faculty member who will supervise the work and assign the grade. Staff.

Students may engage in planned, semiprofessional, or professional practice in an educational enterprise. Each student prepares a plan of action including rationale, purposes, and procedures and arranges with a faculty member to supervise and evaluate the field experience.

#### **EDUC 430 Special Problems in Agricultural Education**

Fall, spring, or summer. 1-3 credits. S-U grades optional. W 12:20-1:10. R. E. Steele.

An opportunity to study individually selected problems in agricultural education.

#### **EDUC 432 Teaching Agriculture: Methods, Materials, Practice**

Fall. 9 credits. Prerequisites: EDUC 332 and concurrent registration in EDUC 430 and 497. M T W R F 8:00-3:00. R. E. Steele.

Directed participation in teaching agriculture at the secondary school level. Program includes a five-day intensive on-campus period and periodic seminars addressing selected methods and materials in teaching agriculture, combined with a 14-week period in an off-campus student teaching center. Includes evaluation of area resources, instructional materials and facilities, planning and executing instruction, directing work experience, and advising youth organizations.

#### **[EDUC 445 Curriculum Design Workshop**

Fall. 3 credits. Not offered 1996-97. T R 10:10-11:25. G. J. Posner.

A general practical approach to course planning. Readings, group discussions, workshops, and individual conferences centering on each student's project. This project consists of designing a course in a subject area for an age level and an institutional setting of the student's choosing.]

#### **EDUC 472 Philosophy of Education**

Fall. 3 credits. T 2:30-4:25. K. A. Strike. A study of central issues in the philosophy of education. Questions of ethics, political philosophy, and the theory of knowledge are examined and linked to current educational issues.

#### **[EDUC 475 Epistemology and Teaching**

Spring. 3 credits. Letter grade only. T R 3:30-4:45. Not offered spring 1997; next offered spring 1998. K. A. Strike.

This course emphasizes the critical examination of recent debates in philosophy of science concerning the nature of scientific knowledge and scientific inquiry. It applies these inquiries to such questions as the organization of curricular materials, the nature of effective science teaching, and the role of scientific knowledge in the deliberations of a liberal democracy.]

#### **EDUC 477 Law and Educational Policy**

Fall. 3 credits. M 2:30-4:25. K. A. Strike. A study of recent federal court decisions concerning education. Emphasis on examining legal issues against a background of related educational issues and in terms of the consequences of legal decisions for the development and operation of educational institutions.

#### **[EDUC 481 Educating for Community Action**

Spring. 3 credits. Not offered 1996-97. D. M. Ewert.

The design and execution of educational aspects of community-action and nonformal education programs. Deals with the identification and statement of educational goals, selection of teaching strategies, and evaluation of outcomes.]

#### **EDUC 483 Comparative Studies in Adult Education**

Spring. 3 credits. S-U grades optional. T R 3:35-5:00. J. D. Deshler.

Focuses on the variety of adult-education programs in countries around the world. Literature on comparative adult education, international conferences on adult education, UNESCO adult-education publications, and international community development are analyzed in relationship to each student's exploration of adult education in two countries. Description of adult education in other countries is shared by international students.

#### **EDUC 494 Special Topics in Education**

Fall or spring. 4 credits maximum. S-U grades optional. Hours to be arranged. Staff.

The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

#### **EDUC 497 Individual Study in Education**

Fall or spring. 1-3 credits. S-U grades optional. Students must register with an Independent Study form (available in 140 Roberts Hall). Hours to be arranged. Staff.

A student may, with approval of a faculty adviser, study a problem or topic not covered in a regular course or may undertake tutorial study of an independent nature in an area of educational interest.

#### **EDUC 498 Undergraduate Teaching**

Fall or spring. 1 or 2 credits; 4 credits maximum during undergraduate career. Limited to students with grade-point averages of at least 2.7. S-U grades optional. Students must register with an Independent Study form (available in 140 Roberts Hall). Hours to be arranged. Staff.

Participating students assist in teaching a course allied with their education and experience. Students are expected to meet regularly with a discussion or laboratory section, to gain teaching experience, and regularly to discuss teaching objectives, techniques, and subject matter with the professor in charge.

**EDUC 499 Undergraduate Research**

Fall or spring. 6 credits maximum during undergraduate career. Not open to students who have earned 6 or more undergraduate research credits elsewhere in the college. Limited to juniors and seniors with grade-point averages of at least 2.7. Students must register with an Independent Study form (available in 140 Roberts Hall). Hours to be arranged. Staff.

Affords opportunities for students to carry out independent research under appropriate supervision. Each student is expected to review pertinent literature, prepare a project outline, conduct the research, and prepare a report.

**EDUC 501 Communication Workshop**

Summer and intersession. 2-3 credits. S-U grades optional. M. D. Glock.

The course focuses on skills enabling individuals to cope with such concerns as motivation, dealing with difficult persons, criticizing productively, improving comprehension, adjusting to different learning styles, and communicating with the public. Practice is coordinated with theory and research findings. The ongoing dynamics of the course necessitate intense participation over a period of time, not provided by regularly scheduled fifty-minute class periods. Additional auto-tutorial lab time is scheduled. Appropriate for anyone who works with people.

**EDUC 507 Science and Environment for Teachers**

Summer. 3 credits. S-U option. Prerequisite: contact instructor for details. W. S. Carlsen.

This three-week inservice program for secondary and middle school science teachers focuses on biological, chemical, and hydrological methods of water monitoring and watershed dynamics. Participants also use remote sensing; work with computers; investigate topics in science, technology and society; learn pedagogical techniques that are consistent with science reform initiatives; and discuss and develop new types of assessment.

**EDUC 513 Interpersonal Interaction**

Summer. 1-2 credits. D. E. Hedlund.

Designed to develop skills for an understanding of effective interpersonal communication and interaction. Appropriate for students in the helping professions, education, and areas involving management of human resources. A workshop design is required for the second credit. Participants must bring a tape recorder to class.

**EDUC 547 Improvement of College Teaching**

Summer. 2 credits. Staff.

Concepts of teaching, learning, curriculum, and governance are used to guide practical activities that enhance faculty competence. Recent studies of concept mapping and learning, structure of knowledge, science teaching, adult learning, and evaluation provide a conceptual basis for improving teaching.

**EDUC 548 Effective College Teaching**

Spring. 1-3 credits. S-U grade option. Hours to be arranged. H. D. Sutphin, D. M. Ewert, and D. J. Trumbull.

This course is designed to help participants become more effective college teachers. It will examine the basic principle of learning, identify different learning styles, and explore a

variety of teaching techniques, methods, and technologies. Participants will also learn how to design a course and improve their effectiveness as teachers.

**EDUC 601 Secondary Science and Mathematics Teaching Practicum**

Fall or spring. 6 credits. Prerequisite: permission of instructor. Letter grades only. For graduate students enrolled in the Teacher Education in Science and Mathematics program. M T W R F 8:00-3:00. W. S. Carlsen, G. J. Posner, A. Solomon, M. S. Slack, and D. J. Trumbull.

Supervised student teaching in science or mathematics at the secondary level. Program includes teaching in a local school for ten weeks.

**EDUC 602 Teaching Science/Mathematics: Methods, Materials, Practice**

Fall or spring. 9 credits. Prerequisite: concurrent enrollment in EDUC 601 or permission of instructor. M T W R F 9:00-3:00. W. S. Carlsen and staff.

The course begins with full day sessions of intensive consideration of theoretical frameworks relevant to all aspects of student teaching. Assignments and a weekly seminar during the semester require students to use those theories to develop and evaluate teaching materials and practices. Students will complete an extensive portfolio documenting their work.

**[EDUC 603 Teaching Mathematics**

Fall. 3 credits. Offered alternate years. Not offered 1996-97. T R 10:10-11:25. J. Confrey.

Current research in mathematics education will be examined in order to develop a picture of the mathematics classroom that integrates subject matter, student conceptions, affective variables, and issues in the social context of learning mathematics. Special topics will include research on problem solving, women and mathematics, misconceptions, and research on teaching.]

**EDUC 606 Seminar in Science and Mathematics Education**

Fall. 1 credit. S-U grades only. T 4:30-5:30. J. Confrey.

Explores topics in science and mathematics education. The focus of the seminar changes each year.

**[EDUC 609 Educational Ethnography**

Spring. 3 credits. Prerequisite: course in research methods or measurement or permission of instructor. M W 2:30-4:00. Not offered spring 1997; next offered spring 1998. D. J. Trumbull.

The course will study educational ethnography as a form of interpretive research, a perspective that attends to the complex interactions between researcher, researched, and context and accepts the centrality of meaning-making in the conduct of human affairs. Students will examine some of the philosophical debates about research approaches and will discuss research methods as they relate to the aims and assumptions of interpretive research. Students will conduct a joint research project during the course of the semester.]

**EDUC 611 Educational Psychology**

Fall. 3 credits. Prerequisite: introductory psychology. S-U grades optional. M W 11:15-12:05. R. E. Ripple.

A basic survey course for graduate students. Emphasis on psychological factors involved in human learning and the educational process. Set in a broad-based conceptual model of any behavioral setting for learning. A life span developmental approach is used, appropriate for those seeking an introduction to educational psychology or a refresher course in contemporary educational psychology.

**EDUC 614 Epistemological Development and Reflective Thought**

Fall. 3 credits. S-U grades optional. M 12:20-2:15. D. E. Schrader.

Insight into how individuals make sense of knowledge is essential to teaching and learning. This course examines theories of intellectual development and their implications for educating students of various age groups, particularly college students. The role of reflection on thinking (metacognition) and its impact on development of thought is explored.

**[EDUC 615 Self and Interpersonal Development and Education**

Spring. 3 credits. S-U grades optional. Not offered 1996-97. M 12:20-2:15. D. E. Schrader.

Interpersonal interactions affect teaching and learning. This course takes a life-span perspective as it explores constructive-developmental theories of self and others, and how such theories explain students' understanding of their own and others' actions in educational contexts.]

**EDUC 620 Internship In Education**

Fall or spring. 1-6 credits. S-U grades optional. Each student, before course enrollment, must obtain the approval of a faculty member who will assume responsibility for supervising the work. Staff.

An opportunity for practical experience in educational professions development.

**EDUC 621 Work-Experience Coordinator Certification Course I**

Summer. 3 credits. S-U grades optional. Staff.

The first of a two-course sequence designed to develop the competencies needed for certification as a coordinator of diversified cooperative work experience programs. The course focuses on the history and philosophy, types, operation, and evaluation of work-experience programs including articulation with JPTA and VESID. Field interviews are required. A prerequisite for Course II, EDUC 622.

**EDUC 622 Work-Experience Coordinator Certification Course II**

Summer. 3 credits. Prerequisite: EDUC 621 Work-Experience Certification Course I. Staff.

The second course for certification as a diversified cooperative work experience coordinator combines course work and directed field experience leading to the planning, development, and approval of a work-experience program in a local educational agency. Development of a philosophy and policy statement, budget, curriculum for related instruction, annual work plan by function, promotional materials, and all program forms for Board of Education approval required.

**EDUC 630 Special Problems in Agricultural Education**

Fall or spring; may also be offered in summer. 1-3 credits. S-U grades optional. Hours to be announced. Staff.

The course provides an opportunity for graduate-level study of individually selected problems and issues in agricultural and occupational education. Designed for experienced teachers.

**EDUC 632 Teaching Agricultural, Extension, and Adult Education**

Spring. 3 credits. Prerequisite: an introductory course in teaching methods or permission of instructor. M 8:00-10:00. Staff.

The focus of the course is on the selection, use, and evaluation of methods and materials for teaching. Methods for group and informal instruction are covered. Opportunity is provided for students to develop teaching competence based on their individual needs and interests. Development of self-evaluation skills is included. A class project on the development of instructional materials is required.

**EDUC 633 Program Planning in Agricultural, Extension, and Adult Education**

Fall. 3 credits. Field trip. Lec, T 2:00-4:30; lab, to be announced. R. E. Steele.

Current social and economic conditions affecting agricultural, extension, and adult education are examined. Principles, objectives, strategies, and sources of information are applied to program planning. Participants have an opportunity to observe ongoing programs in agricultural, extension, and adult education, and to pursue individual interests in program development and improvement.

**EDUC 644 Curriculum Theory and Analysis**

Spring. 3 credits. M 2:30-5:00. G. J. Posner and W. S. Carlsen.

An examination of the basic elements involved in making curriculum decisions and an analysis of current approaches to curriculum. The course focuses on the assumptions underlying any curriculum. The major task of each student is to choose and conduct an in-depth analysis of a curriculum. This course is the basic graduate course in curriculum.

**EDUC 647 Instructional Technologies: Analysis and Practices**

Fall. 2-4 credits. Prerequisite: skills in statistics and research design. Letter grade only. Lec, R 2:30-3:20; lab and seminar to be announced. D. D. Peasley.

Current research and literature on instructional computing and related technologies in the public and private sectors will be examined. Students complete a group research project on educational technologies and meet for five seminar sessions to earn 2 credits. The research experience includes design, data collection, input, analysis, and synthesis. Concurrent attendance in ED 247 Modules A and B is required (2 credits); or the modules may be taken as a prerequisite.

**EDUC 650 Methods of Educational Inquiry**

Fall. 1 credit. J. Millman.

A survey of approaches to inquiry in the social sciences, including experimental and comparative designs, survey research, case study, philosophical and historical inquiry, content analysis, and secondary data analysis. The course is intended to broaden the

student's views of appropriate methods of disciplined inquiry.

**EDUC 651 Writing a Thesis Proposal**

Fall. 1 credit. S-U grades only. T 3:35-4:25. J. Millman.

Procedures for developing and writing a master's or doctoral thesis proposal. Emphasis will be given to identifying a significant topic, recognizing weaknesses in illustrative proposals, and clear and concise writing. Students will be provided ample assistance in constructing a brief thesis proposal of their own.

**EDUC 659 Special Topics in Research Methods**

Spring. 2-3 credits. Prerequisite: permission of instructor. S-U grades only. Hours to be arranged. J. Millman.

Consideration of new techniques and current topics in educational research design, measurement, or evaluation of programs, products, and personnel.

**EDUC 661 Administration of Educational Organizations**

Fall. 3 credits. W 3:35-6:00. E. J. Haller.

Perspectives on the administration of educational organizations. Consideration of social science, legal and ethical theories, and their application to both public schools and higher education. Intended for students who are considering careers as educational administrators, as well as for those who want to further their understanding of schools as organizations.

**EDUC 664 Educational Finance**

Fall. 3 credits. S-U grades optional. R 3:35-6:00. D. H. Monk.

An analysis of the distribution and utilization of public and private resources for educational purposes. The discussion will revolve around the issues of equity, efficiency, and freedom of choice. Alternative methods of financing schools will be evaluated, and the perplexing legal and moral issues raised by such questions as "Who pays?" and "Who benefits?" will be discussed. Specific attention will be given to budgeting, accountability, and productivity. An opportunity for individuals to focus on their own areas of interest, such as occupational education, the two-year college, or secondary or higher education.

**EDUC 665 Administrative Decision Making**

Spring. 3 credits. S-U grades optional. W 3:35-6:00. D. H. Monk.

An introduction to decision making theory and its relevance to the field of educational administration. Specific applications will be made to the study and improvement of productivity within educational systems. A wide variety of educational settings will be considered, including higher education and non-formal education.

**EDUC 680 Foundations of Extension Adult Education**

Fall. 3 credits. Limited to 20 students. S-U grades optional. F 9:05-12:10. J. D. Deshler.

An analysis of alternative purposes, nature, and scope of extension, adult, and continuing education programs in the United States and abroad, with emphasis on the relationship of programs to historical, cultural, political, and social settings. Definitions, conceptual controversies, philosophical issues, and current research directions will be examined through a seminar approach.

**EDUC 682 Community Education and Development**

Fall. 3 credits. Limited to 25 students. Letter grade only. M 1:25-4:25. D. M. Ewert.

An examination of the concept of community; changes in community life; the analysis of community; alternative strategies for community development; patterns of response to community by universities, colleges, schools, cooperative extension, and government service agencies; and such functional dimensions of community education programming as participatory decision making, volunteers, leadership development, council formation and function, interagency coordination, and change-agents roles.

**EDUC 685 Training and Development: Theory and Practice (also Communication 685, International Agriculture 685)**

Spring. 4 credits. S-U grades optional. Charge for materials, \$45. F 9:05-12:05; lab to be arranged. R. D. Colle and J. D. Deshler.

Analysis, design, conduct, administration, and evaluation of training programs for the development of human resources in small-farm agriculture, rural health and nutrition, literacy and nonformal education, and general community development. Designed for scientists, administrators, educator-trainers, and social organizers in rural and agricultural development programs in the U.S. and abroad.

**EDUC 690 Research Seminar**

Fall and/or spring. No credit. G. J. Posner and staff.

Presentation of current research in the field of education by graduate students and staff. Opportunities to discuss methodology, findings, and other aspects of research.

**EDUC 694 Special Topics in Education**

Fall, spring, or summer. 1-3 credits. Prerequisite: permission of instructor. S-U grades optional. Hours to be arranged. Staff.

Topics to be announced.

**[EDUC 711 Contemporary Issues in Educational Psychology]**

Fall and spring. 2-3 credits. Fall: M W 11:15. J. Dunn. Spring: hours to be arranged. R. E. Ripple.

This is a graduate-level seminar dealing with key issues in contemporary psychology having implications for educational practice and research. Topics will vary from semester to semester. Students may take the course more than once.]

**EDUC 714 Moral Development and Education**

Spring. 3 credits. S-U grades optional. M 12:20-2:15. D. E. Schrader.

This seminar focuses on current topics in moral development research as related to the educational process. Topics include the question of the development of moral reasoning, gender differences, the relationship between moral judgment and moral action, questions related to moral education in secondary schools and university settings, and professional ethics in educational settings. This course takes a life-span perspective; however, special emphasis will be placed on development from adolescence through adulthood.

**EDUC 715 Seminar in Psychology and Education**

Fall. Variable credit. Prerequisite: permission of instructor. Fall: W 1:25-3:25. D. E. Hedlund.

Selected topics focusing on the interaction of theoretical and research developments in psychology and education.

**EDUC 718 Adult Learning and Development**

Spring. 3 credits. Prerequisite: permission of instructor. S-U grades optional. W 2:30-5:00. R. E. Ripple and J. D. Deshler.

Deals with adult development and learning behavior from points of view of educational psychology, and adult education. Inferences are drawn from theory and research to the practice of adult continuing education. Appropriate for graduate students in educational psychology, extension and continuing education, and community service education, and for others interested in adult learning and development.

**[EDUC 730 Seminar in Agricultural, Extension, and Adult Education]**

Spring. 2 credits. S-U grades optional. R 8:00-9:55. Not offered 1996-97. D. M. Ewert.

Emphasis on current problems and research in agricultural, extension, and adult education. Includes discussion and analysis of student and staff research.]

**EDUC 739 Evaluating Programs in Agricultural, Extension, and Adult Education**

Spring. 3 credits. Field trip. Staff.

This course examines objectives, criteria, and strategies for evaluating programs of agricultural, extension, and adult education. Evaluation models, case studies, and evaluation as a function of program planning are considered. Participants examine the roles of supervision in evaluation and have an opportunity to develop and apply evaluation instruments. Field trips and resource persons provide opportunities to observe actual evaluation problems and procedures.

**[EDUC 745 Seminar in Curriculum Theory and Research]**

Fall. 3 credits. Prerequisite: EDUC 644, or permission of instructor. T 2:30-5:00. Not offered 1996-97. G. J. Posner.

Theoretical issues in curriculum and appropriate areas for curriculum research are discussed. Two current topics of interest are the hidden curriculum and school reform. Both topics serve to uncover the relation between ideology and research.]

**EDUC 762 Research in Educational Administration**

Spring. 3 credits. Prerequisite: one course in elementary statistics or permission of instructor. S-U grades only. E. J. Haller.

For students interested in learning about the process of formulating and carrying out a piece of empirical research. Studies will focus on policy and administrative issues concerning public education. Seminar participants will have access to large, nationally representative data sets that will permit them to conduct high-quality, publishable studies of U.S. schools, students, teachers, and parents. In the process they will learn some of the costs and benefits of secondary data analysis and gain some familiarity with statistical analyses on a Cornell mainframe computer.

**EDUC 772 Seminar in Philosophy of Education**

Spring. 3 credits. Prerequisite: permission of instructor. S-U grades optional. W 9:00-11:00. K. A. Strike.

Topics to be announced.

**EDUC 783 Comparative Extension Education Systems**

Summer. 3 credits. S-U option. D. M. Ewert.

Extension education in the developing nations is studied using, as an analytical frame of reference, a hypothetical model comprising such components as community organization, community-based learning, indigenous facilitators and leaders, extension generalists and specialists, training and research-extension linkages. Case materials on alternative extension models and intercountry experiences provide an empirical base.

**[EDUC 784 Educational Technology-Transfer and Decision Making]**

Fall. 3 credits. Offered odd years only. Not offered 1996-97. H. D. Sutphin and J. McGonigal.

The educational and program management decisions involved in the adoption of educational technology in extension, rural development, and nonformal education programs are reviewed, and a variety of decision-making approaches is explored. An overall problem-solving method with case study illustrations is used. Consideration is given to structure and operating style of the educational organization, as well as to the characteristics of the technology under consideration. The course makes use of recent literature and continuously updated files on current developments in technology applications.]

**EDUC 800 Master's-Level Thesis Research**

Fall or spring. Credit to be arranged. S-U grades optional. Each student, before course enrollment, must obtain the approval of a faculty member who will assume responsibility for guiding the work. Hours to be arranged. Staff.

**EDUC 900 Doctoral-Level Thesis Research**

Fall or spring. Credit to be arranged. Limited to students working on theses or other research and development projects. S-U grades optional. Each student, before course enrollment, must obtain the approval of a faculty member who will assume responsibility for guiding the work. Hours to be arranged. Staff.

**ENTOMOLOGY**

D. A. Rutz, chair; N. W. Calderone, B. N. Danforth, P. M. Davis, P. P. Feeny, C. Gilbert, A. E. Hajek, M. P. Hoffmann, J. K. Liebherr, R. A. Morse, L. A. Patrican, B. L. Peckarsky, D. Pimentel, L. S. Raylor, R. B. Root, R. T. Roush, J. P. Sanderson, J. G. Scott, A. M. Shelton, E. J. Shields, M. J. Tauber, W. M. Tingey, S. Via, Q. D. Wheeler

**Courses by Subject**

Apiculture: 260, 264  
Behavior: 215, 471, 662  
Ecology: 452, 455, 456, 470, 471, 672  
Introductory courses: 201, 212, 215

Medical entomology and veterinary entomology: 352

Morphology: 322

Pathology: 463

Pest management: 241, 441, 444, 477, 640

Physiology and toxicology: 370, 483, 490, 685

Systematics: 331, 453, 631, 632, 634

**Note:** class meeting times are accurate at the time of publication. If changes are necessary, the department will provide new information as soon as possible.

**ENTOM 201 Six-legged Science**

Spring. 2 credits. S-U grades optional.

Offered alternate years. Not offered fall 1996 and 1997; next offered spring 1997 and fall 1998 and alternate fall semesters thereafter. Lects, T R 9:05; optional field trips, required lab demonstrations.

A. E. Hajek.

Fascinating, frightening, innocuous, injurious, dainty and ethereal, abundant and essential. Visit the amazing world of the insects.

Lectures will explore aspects of the wonders of the insects, and their interactions with humans. We will offer opportunities to investigate insects in the field and laboratory.

**ENTOM 212 Insect Biology**

Fall. 4 credits. Prerequisites: BIO G 101-102 (may be taken concurrently) or equivalent. Lects, W F 10:10-11:00; labs T, W or R 1:25-4:25. J. K. Liebherr.

Introduces the science of entomology by focusing on basic principles of systematics, morphology, physiology, behavior, and ecology of insects. The laboratory in early fall includes field trips to collect and study insects in the natural environment. A collection emphasizing ecological, behavioral and taxonomic categories is required.

**ENTOM 215 Spider Biology: Life on a Silken Thread**

Fall. 2 credits. Prerequisite: Introductory biology or permission of instructor. S-U grades optional. Lects, M W 1:25-2:15. L. S. Raylor.

An introduction to the fascinating world of spiders. Evolution, ecology, behavior, and physiology of spiders and their close kin from a modern perspective. Topics include identification of major spider families, spiders' unique use of silk, risky courtship, predatory behavior, diverse life styles, social spiders, sensory physiology, and potential use in IPM.

**ENTOM 241 Applied Entomology**

Spring. 3 credits. Prerequisites: BIO G 101-102 or equivalent. Lects, T R 9:05; lab/disc, T or W 12:20-3:15. W. M. Tingey.

Introduction to major pest species and tactics for their management. Discussions of insect pest management requirements on farms, gardens, forests, and urban environments, along with descriptions of control methods, materials, and equipment.

**ENTOM 260 Introductory Beekeeping**

Fall. 2 credits. Lects, T R 11:15. R. A. Morse.

Introduces the fundamentals of practical beekeeping, including the life history, physiology, and behavior of honey bees. The classical experiments on the dance language and the role of pheromones are reviewed. Some lectures are devoted to pollination of agricultural crops and the production of honey and beeswax.



**ENTOM 264 Practical Beekeeping**

Fall. 1 credit. Limited to 20 students. Prerequisite: ENTOM 260 (may be taken concurrently). Lab, R 2-4:25. R. A. Morse.

This course consists of fourteen laboratory sessions to acquaint students with practical methods of colony management. Laboratories involve actual work with honey bee colonies and equipment. Some of the topics covered are management of bees for apple pollination, honey harvesting and processing, and disease identification and control.

**ENTOM 322 Insect Morphology**

Spring. 5 credits. Prerequisite: ENTOM 212 or 241. Offered alternate years. Not offered spring 1998; next offered spring 1997 and 1999. Lects, M W F 9:05; labs, M F 1:25-4:25. B. N. Danforth.

An introduction to the external and internal anatomy of insects, with emphasis on the comparative and functional aspects. The laboratory is devoted largely to dissection.

**[ENTOM 331 Introductory Insect Systematics]**

Spring. 4 credits. Prerequisite: ENTOM 212. Offered alternate years. Not offered spring 1997 and 1999; next offered spring 1998. Lects, T R 10:10; labs, M W 1:25-4:25. Q. D. Wheeler.

An introduction to the classification, evolutionary history, and distribution of the insects. Laboratory practice in the identification of orders, families, and representative genera of insects; methods of collection, preservation, and study. Lectures on theory and practice of insect systematics and major features of insect evolution. Insect collections are required.]

**ENTOM 352 Medical and Veterinary Entomology**

Fall. 3 credits. Prerequisites: BIO G 101-102 or equivalent. S-U grades optional. Offered alternate years. Not offered fall 1997; next offered fall 1996 and 1998. Lects, T R 10:10; lab, R 1:25-4:25. L. A. Patrican.

The ecology of arthropods of medical and veterinary importance in temperate and tropical regions of the world with emphasis on the role they play in causation or transmission of disease. The laboratory involves 2 field trips, techniques of collection and identification, dissections, methods of transmission, means of identification of a blood pathogen and the source of a blood meal.

**ENTOM 370 Pesticides, the Environment, and Human Health (also Toxicology 370)**

Fall. 2 credits. Prerequisites: BIO G 101-102 or equivalent. Offered alternate years. Not offered fall 1997; next offered fall 1996 and 1998. Lects, T R 9:05. J. G. Scott.

A survey of the different types of pesticides, their uses, properties, and effects on the environment. Discussion of the risks, benefits, regulation, politics, and current controversies associated with pesticide use.

**[ENTOM 441 Seminar in Insect Pest Management]**

Spring. 1 credit. Limited to 15 students. Prerequisite: ENTOM 241 or 444 or permission of instructor. S-U grades only. Offered alternate years. Not offered spring 1997 and 1999; next offered spring 1998. Hours to be arranged. M. P. Hoffmann and A. M. Shelton.

Discussion and analysis of current topics in insect pest management.]

**ENTOM 444 Integrated Pest Management (also Plant Pathology 444)**

Fall. 4 credits. Prerequisites: BIOES 261, ENTOM 212 or 241, and PL PA 301 or their equivalents or permission of instructor. Lects, M W F 9:05; labs M or T 1:25-4:25. P. Arneson.

Lectures integrate the principles of pest control, ecology, and economics in the management of pest-crop systems. Laboratories consist of exercises to reinforce concepts presented in lecture and demonstrate pest monitoring techniques and the application of computer technology to management problems.

**ENTOM 452 Herbivores and Plants: Chemical Ecology and Coevolution (also BIOES 452)**

Spring. 3 credits. Prerequisites: one year of introductory biology; BIOES 261; CHEM 253 or 357/358 and 251 or 301; or permission of instructor. Offered alternate years. Not offered spring 1998; next offered spring 1997 and 1999. Lects, M W F 11:15. P. P. Feeny.

Significance of plant chemistry in mediating interactions between plants and herbivorous animals; mechanisms and strategies of plant finding and exploitation by animals; especially insects, and of defense and escape by plants; evolutionary hypotheses for ecological patterns of resistance and attack; implications for human food and agriculture.

**[ENTOM 453 Principles and Practice of Historical Biogeography (also BIOPL 453)]**

Fall. 3 credits. Prerequisite: A course in systematics or permission of instructors. S-U grades optional. Offered alternate years. Not offered fall 1996 and 1998; next offered fall 1997. Lects, T R 10:10; lab T 1:25-4:30. J. K. Liebherr and M. Luckow.

A survey of techniques in historical biogeography, and the development of modern biogeographic theory in the context of classical, ecological and phylogenetic analytical methods. Geological and paleontological aspects of biogeography will be presented, and large-scale biogeographic patterns discussed. Laboratories will focus on computer applications and discussion of controversial issues.]

**[ENTOM 455 Insect Ecology, Lectures (also BIOES 455)]**

Fall. 3 credits. Prerequisites: BIOES 261 or equivalent and ENTOM 212 or equivalent knowledge of another taxon. S-U grades optional. Offered alternate years. Not offered fall 1996 and 1998; next offered fall 1997. Lects, M W F 11:15. R. B. Root.

Topics include the nature and consequences of biotic diversity, biogeography, coevolution, adaptive syndromes exhibited by various guilds, population regulation, impact of insects on ecosystems, comparative and functional analysis of communities, and differences in the organization of natural and managed systems. Ecological and evolutionary principles are integrated by thorough study of exemplars.]

**ENTOM 456 Stream Ecology (also BIOES 456)**

Spring. 4 credits. Recommended: BIOES 261. S-U grades optional. Offered alternate years. Not offered spring 1998; next offered spring 1997 and 1999. Lects,

T R 9:05; labs, T W or R 1:25-4:25.

B. L. Peckarsky and M. B. Bain.

Lecture addresses the patterns and processes occurring in stream ecosystems, including channel formation, water chemistry, watershed influences, plant, invertebrate, and fish community structure, nutrient cycling, trophic dynamics, colonization and succession, community dynamics, conservation and the impacts of disturbances. Lab: A field project includes descriptive and experimental techniques and hypotheses testing related to environmental assessment.

**[ENTOM 463 Invertebrate Pathology]**

Spring. 4 credits. Prerequisites: one year of introductory biology. S-U grades optional. Offered alternate years. Not offered spring 1997 and 1999; next offered spring 1998. Lects, M W F 9:05; labs, W 1:25-4:25. A. E. Hajek.

Lecture presents principles of pathology as applied to invertebrates. Topics explored include non-infectious and infectious diseases caused by viruses, bacteria, fungi, protozoa, and nematodes, epizootiology of insect diseases and use of pathogens for control. Laboratory involves a diversity of pathogens and hosts using techniques such as microinjection, electrophoresis, immunoassay, density gradient centrifugation, soil extraction, and computer simulation.]

**ENTOM 470 Ecological Genetics (also BIOES 470)**

Spring. 4 credits. Prerequisites: BIOES 378 or permission of instructor. S-U grades optional. Offered alternate years. Not offered spring 1998; next offered spring 1997 and 1999. Lects, T R 10:10-11:30; disc, 1 hr/wk to be arranged. S. Via.

A study of the relationships between genetic and ecological processes in populations. Topics include consequences of genetic variation in age-structured populations; demographic concepts of fitness; evaluation of methods for measuring genetic variation and natural selection on ecologically important traits; genetics of competitive ability and predator avoidance; genetic and ecological aspects of phenotypic plasticity; character displacement; maintenance of genetic variability; limits to selection. How theory can be used to formulate hypotheses about evolutionary mechanisms in natural populations is considered and experiments designed to test such hypotheses are evaluated.

**[ENTOM 471 Freshwater Invertebrate Biology]**

Spring. 5 credits. Recommended: ENTOM 212. Offered alternate years. Not offered spring 1997 and 1999; next offered spring 1998. Lects, T R 9:05; labs, T R 1:25-4:25. B. L. Peckarsky.

The lecture explores the morphology, physiology, phylogeny, life histories, behavior, feeding ecology, and evolution of macroscopic freshwater invertebrates with an emphasis on contrasting the attributes of aquatic and terrestrial insects. The laboratory involves field collections and laboratory identification of invertebrates and stresses the use of keys. Students prepare a collection of freshwater invertebrates.]

**[ENTOM 477 Biological Control]**

Fall. 3 credits. Prerequisites: ENTOM 212, BIOES 261, and permission of instructor. Offered alternate years. Not offered fall 1996 and 1998; next offered fall 1997. Lects, T R 9:05; lab T 1:25-4:15. M. J. Tauber.

Approach and procedures in biological control of arthropod pests and weeds. Demonstrations focus on living parasitoids and predators. Discussions focus on case histories.]

**ENTOM 483 Insect Physiology**

Fall. 5 credits. Prerequisite: ENTOM 212 or permission of instructor. Offered alternate years. Not offered fall 1997; next offered fall 1996 and 1998. Lects, M W F 11:15; lab W 1:25-4:25. C. Gilbert.

An introduction to the often unique ways in which insects have met their basic needs. Each organ system is examined with emphasis on basic principles and specific examples. The student will also be introduced to some common methods used in physiological research and to the critical reading of scientific literature.

**ENTOM 490 Toxicology of Insecticides (also Toxicology 490)**

Spring. 4 credits. Prerequisites: general chemistry and organic chemistry. S-U grades optional. Offered alternate years. Not offered spring 1998; next offered spring 1997 and 1999. Lects, M W F 9:05; lab W 1:25-4:25. J. G. Scott.

The history, metabolism, and mechanism of action of synthetic and naturally occurring insecticides. Mechanisms of insecticide resistance, evaluation of insecticide toxicity, and new approaches to insect control with biotechnology will be discussed.

**ENTOM 494 Special Topics in Entomology**

Fall or spring. 4 credits maximum. S-U grades optional. Hours to be arranged. Staff.

The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

**ENTOM 497 Individual Study in Entomology**

Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. Students must register with an Independent Study form (available in 140 Roberts Hall). Staff.

**ENTOM 498 Undergraduate Teaching**

Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. Undergraduate teaching assistance in an entomology course by agreement with the instructor. Students must register with an Independent Study form (available in 140 Roberts Hall). Staff.

Participating students assist in teaching a course allied with their education and experience. Students are expected to meet regularly with a discussion or laboratory section, to gain teaching experience, and regularly to discuss teaching objectives, techniques, and subject matter with the professor in charge.

**ENTOM 631 Systematics of the Coleoptera**

Summer. 3 credits. Max enrollment 18 students. 3 week summer session. Prerequisites: an introductory course in insect taxonomy and permission of instructor. Offered alternate years. Not offered summer 1998; next offered summer 1997 and 1999. Lab, M T W R F 9-4; Saturday field trips. Q. D. Wheeler.

A comprehensive review of the comparative morphology, phylogenetic relationships, classification, natural history, and distribution of the Coleoptera, including adult and immature stages. Laboratory practice in identification and methods for collection and study of beetles. A collection is required.

**[ENTOM 632 Advanced Coleopterology]**

Summer. 1-3 credits. Prerequisite: permission of instructor. S-U grades optional. Offered alternate years. Not offered summer 1997 and 1999; next offered summer 1998. Lab, to be arranged. Q. D. Wheeler.

An advanced course on the phylogeny and classification of selected subclades of Coleoptera. Laboratory exercises in identification of beetles, generally to the level of genus or beyond. Taught by authority on taxon of interest, frequently including a visiting scholar. Can be repeated for credit.]

**ENTOM 634 Special Topics in Systematic Entomology**

Fall or spring; taught on demand. 2-4 credits. Prerequisite: permission of instructor. Staff.

Lectures on the classification, evolution, and bionomics of selected taxa, with accompanying laboratory studies on identification and comparative morphology. Collections sometimes required.

**ENTOM 640 Applied Ecology and Pest Management**

Spring. 3 credits. Prerequisites: ENTOM 444 and a course in statistics. Recommended: a course in computer science. S-U grades optional. Offered alternate years. Not offered spring 1998; next offered spring 1997 and 1999. Lects, T R 1:25-2:40. P. M. Davis.

Theory and quantitative methods for characterizing arthropod population dynamics for research and pest management purposes. Course evaluates biological and climatic factors influencing population numbers, development, dispersal, and plant response to arthropod pests. Special topics include development of sampling methodology and simulation modeling.

**ENTOM 662 Insect Behavior Seminar**

Spring. 2 credits. Prerequisites: permission of instructor and ENTOM 212 and BIONB 221 or equivalents. S-U grades optional. Offered alternate years. Not offered spring 1998; next offered spring 1997 and 1999. Hours to be arranged. M. J. Tauber.

**[ENTOM 672 Seminar in Aquatic Ecology]**

Spring. 1 credit. Prerequisites: permission of instructor or either ENTOM 456, 471 or BIOES 261, 462. S-U grades optional. Offered alternate years. Not offered spring 1997 and 1999; next offered spring 1998. Hours to be arranged. B. L. Peckarsky.

Discussion and analysis of current topics in the ecology of streams, lakes and marine

ecosystems, including student-generated synthesis of key papers in the literature.]

**[ENTOM 685 Seminar in Insect Physiology]**

Spring. 1 credit. S-U grades optional. Prerequisite: permission of instructor. Offered alternate years. Not offered spring 1997 and 1999; next offered spring 1998. Hours to be arranged. C. Gilbert.]

**ENTOM 694 Special Topics in Entomology**

Fall or spring. 4 credits maximum. S-U grades optional. Hour to be arranged. Staff.

The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

**ENTOM 707 Individual Study for Graduate Students**

Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. Not for thesis research. Staff.

**ENTOM 709 Teaching Entomology**

Credit to be arranged. Staff. Teaching entomology or for extension training.

**ENTOM 800 Master's-Level Thesis Research**

Credit to be arranged. Prerequisite: permission of instructor. S-U grades optional. Staff.

**ENTOM 900 Doctoral-Level Thesis Research**

Credit to be arranged. Prerequisite: permission of instructor. S-U grades optional. Staff.

**Jugatae Seminar**

Fall and spring. A seminar conducted by Jugatae, the entomology club of Cornell University, to discuss topics of interest to its members and guests. All interested undergraduate and graduate students are encouraged to attend.

**FLORICULTURE AND ORNAMENTAL HORTICULTURE**

Floriculture and Ornamental Horticulture courses are listed under Horticultural Sciences.

**Freehand Drawing and Scientific Illustration**

Freehand Drawing and Scientific Illustration courses are offered through the Department of Floriculture and Ornamental Horticulture. Courses are described in the section "Freehand Drawing and Scientific Illustration."

**Landscape Architecture**

The Landscape Architecture Program at Cornell is sponsored by the College of Agriculture and Life Sciences through the Department of Floriculture and Ornamental Horticulture, and the College of Architecture, Art, and Planning. For course descriptions, see Landscape Architecture.

## FOOD SCIENCE

D. D. Miller, chair; T. E. Acree, D. K. Bandler, D. M. Barbano, C. A. Batt, D. H. Beermann, K. J. Boor, M. C. Bourne, J. W. Brady, J. M. Brown, R. A. Durst, R. B. Gravani, T. Henick-Kling, J. H. Hotchkiss, H. T. Lawless, R. A. Ledford, C. Y. Lee, S. Mulvaney, J. M. Regenstein, S. S. H. Rizvi, J. W. Sherbon, K. J. Siebert

**Note:** class meeting times are accurate at the time of publication. If changes are necessary, the department will provide new information as soon as possible.

### FOOD 101 Science and Technology of Foods

Fall. 1 credit. S-U grades only. M 1:25–2:15. J. H. Hotchkiss and staff.

This course explores the application of science and technology to foods. Lectures will elucidate the role of engineering, biotechnology, chemistry, biochemistry, nutrition, toxicology, and microbiology in supplying the world with safe and nutritious food. An overview of food science as a discipline and career choice will be given.

### FOOD 102 Contemporary Perspectives in Food Science

Spring. 1 credit. S-U grades only. F 12:20. Three field trips, 2 on F 1:25–5:00 and one on F 7:30 a.m.–5:30. R. A. Ledford.

A series of seminars dealing with current technological, regulatory, and international developments in food science. Field trips to four or five commercial food plants will be used to illustrate the application of current technologies.

### FOOD 150 Food Choices and Issues

Spring. 2 credits. S-U grades optional. T R 12:20. R. B. Gravani and D. D. Miller.

This course provides Cornell students with the knowledge needed to make healthy food choices. A systematic or holistic approach to food production, processing, distribution, and consumption will be presented. Topics include relationships between food, diet and health; food processing; food safety; and discussions of contemporary issues relating to food quality, safety, and nutritional value.

### FOOD 200 Introductory Food Science

Fall. 3 credits. Prerequisite: one course each in chemistry and biology. M W F 11:15–12:05. J. H. Hotchkiss.

A comprehensive introduction to the principles and practice of food science and technology. Topics include: chemistry of foods; nutritional significance; food formulation, preservation, and processing; microbiology and fermentations; composition and processing of food commodities; and contemporary issues including food safety, regulation, and world food needs. Interrelationships between the chemical, physical, nutritional and quality properties of foods as affected by formulation, processing, and packaging are stressed.

### FOOD 210 Food Analysis

Spring. 3 credits. Prerequisite: CHEM 104 or 208. Lec, M W 12:20; lab, F 12:20–3:20. J. W. Sherbon.

Introduces tests used by food analysts for fats, proteins, carbohydrates, and selected minor nutrients. Emphasis is on understanding and use of good analytical techniques, including gravimetric, volumetric, chromatographic and spectrophotometric methods. A special

project for the total analysis of a complex food provides experience in technique selection, work scheduling, and execution.

### FOOD 250 Kosher and Halal Food Regulations

Spring. 2 credits. Sophomore standing and above. M 7:30–9:35 p.m. J. M. Regenstein.

A comprehensive introduction to kosher and halal foods in the American food industry. The kosher food laws, their origin, and their application in modern food processing will be examined. The nature of the kosher supervision industry in America will be described. Halal laws will also be examined and the interactions between the two communities explored. Current food-related issues in both communities will be reviewed, including recent court decisions striking down laws in the state of New Jersey and the City of Baltimore. Some aspects of ethnic foods will also be considered.

### FOOD 290 Meat Science (also Animal Science 290)

Fall. 2 or 3 credits. Lec, T R 11:15–12:05 p.m.; lab, M or R 12:20–3:20. D. H. Beermann.

An introduction to meat science through a study of the structure, composition, and function of muscle and its conversion to meat. Properties of fresh and processed meat, microbiology, preservation, nutritive value, inspection, and sanitation are also studied. Laboratory exercises include anatomy, meat-animal slaughter, meat cutting, wholesale and retail cut identification, processing, inspection, grading, quality control, and meat merchandising. An all-day field trip to commercial meat plants is taken.

### FOOD 311 Milk and Frozen Desserts

Fall. 2 credits. Prerequisite: FOOD 322 or permission of instructor. Offered alternate years. Not offered 1997–98; next offered fall 1998 and 2000. R 12:20–4:25. D. K. Bandler and D. P. Brown.

Deals with the principles and practices of processing fluid milk products and frozen desserts. The chemical, microbiological, and technological aspects of processing these dairy products are considered. Emphasis will be upon product quality and recognition of factors affecting it.

### FOOD 321 Food Engineering Principles

Fall. 3 credits. Prerequisites: FOOD 200 and Introductory Physics. M W F 9:05–9:55. S. S. H. Rizvi.

Introduces the engineering principles underlying food processes and equipment. Topics covered include thermodynamics, mass and energy balance, fluid mechanics, and heat and mass transport.

### FOOD 322 Food Engineering Laboratory

Spring. 2 credits. Prerequisite: FOOD 321. Lab, T or W 1:25–4:00; lec, T 12:20. S. S. H. Rizvi.

Provides hands-on experience with food engineering processes and measurements. Topics covered include mass and energy balances, rheology, fluid mechanics, heat transfer, refrigeration and psychrometry.

### FOOD 351 Milk Quality

Fall. 1 credit. Prerequisite: AN SCI 350 or equivalent or permission of instructor. F 12:20. D. K. Bandler.

Focuses on the important aspects of farm sanitation and milk handling as they affect

milk flavor and quality. The course is an overview of quality control tests, basic microbiology, cleaning and sanitizing, and special problems in manufacturing and marketing fresh and storable dairy products.

### FOOD 394 Food Microbiology Lectures

Fall. 2 credits. Prerequisites: BIOMI 290 and 291. M W 12:20–1:10. R. A. Ledford.

The major families of microorganisms of importance in foods are studied, with emphasis on the roles of those organisms in food preservation, food fermentations, and public health.

### FOOD 395 Food Microbiology Laboratory

Fall. 2 credits. Prerequisite: BIOMI 291. Graduate students must have permission of the instructor. M W 2:00–4:25. J. M. Brown.

Work includes study of the physiological characteristics of representative food microorganisms, practice in using general and special methods for microbiological testing and control of food products, and practice in the application of a systematic approach to controlling the safety of foods.

### FOOD 396 Food Safety Assurance

Spring. 2 credits. Prerequisite: FOOD 200 or permission of instructor. Offered alternate years. Not offered 1997–98. T R 9:05–9:55. R. B. Gravani.

This course provides information on procedures to control biological, chemical, and physical hazards and assure the safety of foods. Topics include discussions on Hazard Analysis Critical Control Point (HACCP) programs, total quality management, and the application of current technologies in reducing the incidence of foodborne illness. Case studies and exercises will be used to demonstrate and apply the key principles that are discussed.

### FOOD 400 Senior Seminar in Food Science and Technology

Fall. 1 credit. Limited to seniors. M 4:30–5:20. D. K. Bandler.

Students prepare and present a seminar on a topic of current interest in food science and technology.

### FOOD 401 Concepts of Product Development

Spring. 2 credits. Prerequisite: FOOD 200 or equivalent. Offered alternate years. Not offered 1997–98. M W 11:15–12:05. J. H. Hotchkiss.

A discussion of the sequence of events in developing and marketing new food products. Topics include packaging and labeling, food additive and ingredient regulations, taste panels, market testing, market research, and patents.

### [FOOD 405 Food Waste Management

Spring. 2 credits. Prerequisite: FOOD 200 or its equivalent. Offered alternate years. Not offered 1996–97; next offered spring 1998 and 2000. Lec, M 12:20–2:15; lab, M 2:30–4:25. J. M. Regenstein.

Introduction to the principles and practices related to managing wastes from food plants through reduction, reuse, recycling, and composting. Some broader areas of waste management impacting the food industry will also be discussed. Includes field trips which may take all afternoon.]

**[FOOD 406 Cheese and Other Fermented Foods]**

Fall. 2 credits. Prerequisite: background in microbiology. Offered alternate years. Not offered 1996-97; next offered fall 1997 and 1999. R 12:20-4:25. D. K. Bandler.

Principles and practices of fermentation and processing techniques as they apply to cheeses, cultured dairy foods, beers, and related products. Labs will feature unit processes and tastings.]

**FOOD 409 Food Chemistry**

Spring. 3 credits. Prerequisite: BIOBM 330 or 331. M W F 9:05-9:55. Staff.

The chemistry of foods and food ingredients. Chemical and physical properties of water, proteins, lipids, carbohydrates, and other food components/additives are discussed in the context of their functional roles in foods. The effects of chemical changes during processing and storage on quality and nutritional aspects of several food commodity groups (milk, meat, fruits and vegetables, cereals and legumes) are described.

**FOOD 410 Sensory Evaluations of Foods**

Fall. 3 credits. Prerequisite: statistics. M W F 10:10-11:00. H. T. Lawless.

Deals with the sensory techniques used in evaluating the flavor, color, and texture of foods and the evaluation of consumer acceptance. Includes methods for measuring these qualities, underlying psychological principles, statistical methods for analyzing results, and establishing a full-service sensory evaluation program.

**[FOOD 415 Principles of Food Packaging]**

Spring. 3 credits. Offered alternate years. Not offered 1996-97; next offered spring 1998 and 2000. M W F 9:05-9:55. J. H. Hotchkiss.

The chemical and physical properties and manufacture of the basic materials used to construct packaging are discussed. The influence of packaging on shelf life is presented. Emphasis is on newer packaging technologies and materials. Economics, design, and regulation of food packaging are briefly presented.]

**[FOOD 417 Sensory Analysis of Dairy Products]**

Spring. 1 credit. S-U grades optional. Offered alternate years. Not offered 1996-97; next offered spring 1998 and 2000. H. T. Lawless.

A survey of the traditional quality grading techniques used for sensory evaluation of dairy products, and a comparison of those techniques to alternative sensory evaluation procedures. Students will prepare samples for one or two demonstrations of classical dairy defects such as lipid oxidation or hydrolytic rancidity. Tasting and practice in identifying defects will be given in class. Primary attention will be given to sensory quality factors in fluid milk, cheddar cheese, cottage cheese, and ice cream.]

**FOOD 419 Food Chemistry Laboratory**

Spring. 2 credits. Prerequisites: BIOBM 330 or 331 and concurrent registration in FOOD 409. W 12:20-4:30. D. D. Miller and J. M. Brown.

A laboratory course emphasizing fundamental chemical principles and laboratory techniques necessary for an understanding of the chemistry of foods. Relationships between chemical composition and functional, nutritional, and organoleptic properties of

foods are stressed. Many of the laboratory techniques involved are common to those used in biochemistry laboratories (e.g., electrophoresis, chromatography, enzyme assays) but are applied to specific foods or beverages.

**FOOD 423 Unit Operations in Food Manufacturing**

Fall. 4 credits. Intended for seniors and food science majors. Lec, T R 11:15-12:05, lab, T 12:20-4:25. S. J. Mulvaney and S. S. H. Rizvi.

An integrated approach to understanding food manufacturing operations. Topics include major unit operations used for thermalization, freezing and dehydration of foods. Emphasis is placed on the interplay between engineering design of processes and the physical and chemical transformations that occur as food is produced from various commodities. The impact of process conditions on product safety, overall quality, and storage stability are also considered.

**FOOD 430 Understanding Wine**

Spring. 3 credits. Prerequisites: Introductory biology and chemistry or permission of instructor. Students must be 21 years old by the first day of class (Jan. 20, 1997) to enroll. S-U grades optional. T R 2:30-4:25. T. Henick-Kling, T. E. Acree, and H. T. Lawless.

An introduction to wine appreciation through the study of fermentation biology, wine composition, and sensory perception. Samples of wines will be used to illustrate the sensory properties, microbiological processes, and chemical components that determine wine quality. Students will learn to recognize the major features of wine that determine sensory quality and know the processes that produced them. Topics will include the psychology and chemistry of bouquet, taste, and aroma; the microbiology of fermentation and spoilage; and the sensory properties of wines from different grape varieties, viticultural practices, and wine making techniques.

**FOOD 447 International Postharvest Food Systems**

Fall. 2 or 3 credits. Prerequisite: freshman chemistry. S-U grades optional. T R 10:10-11:00. M. C. Bourne and staff.

An interdisciplinary course designed for all undergraduate and graduate students in ALS. Describes postharvest food losses and methods to reduce the loss. Topics include storage and care of unprocessed and minimally processed foods such as cereal grains, fruits, vegetables, tubers, and fish; biology and control of fungi, insects, and vertebrates in foods; chemical causes of quality loss; effects of climate; and economic and social factors affecting food preservation and storage. Emphasis is given to the problems in developing countries. The third credit requires a written case study of a country or commodity.

**FOOD 450 Fundamentals of Food Law**

Spring. 2 credits. Offered alternate years. Not offered 1997-98; next offered spring 1997 and 1999. J. M. Regenstien.

Introduction to the complex array of federal and state statutes and regulations that control the processing, packaging, labeling, and distribution of food, including aspects of safety and nutritive value. Emphasis will be on the Food and Drug Administration and U.S. Department of Agriculture regulations, but the

course also will refer to other regulatory agencies. Emphasis will be placed on how a food or agricultural professional interacts with this legal system.

**[FOOD 456 Advanced Concepts in Sensory Evaluation]**

Spring. 2 credits. Prerequisite: FOOD 410. S-U grades optional. Offered in alternate years. Not offered 1996-97; next offered spring 1998 and 2000. F 1:25-3:25. H. T. Lawless.

Readings and discussions of primary source materials in sensory evaluation, including historical perspectives, psychophysics, perceptual biases, human information processing. Concepts influencing detection of sensory differences, use of rating scales, and characterization of sensory properties will be emphasized.]

**FOOD 490 Commercial Meat Processing (also Animal Science 490)**

Spring. 2 or 3 credits. Lecs, T R 9:05; lab T 1:25-4:25. Field trip to commercial meat processing plants. D. H. Beermann.

A study of the classification, formulation, and production of commercially available processed meat products. Physical and chemical characteristics of meat and nonmeat ingredients; their functional properties; various processing methodologies; microbiology; packaging, handling, and storage; and quality assurance are discussed.

**FOOD 494 Special Topics in Food Science**

Fall or spring. 4 credits maximum. S-U grades optional.

The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

**FOOD 497 Individual Study in Food Science**

Fall or spring. 3 credits maximum.

Prerequisite: permission of instructor. Students must register with an Independent Study form (available in 140 Roberts Hall). S-U grades optional.

May include individual tutorial study, a special topic selected by a professor or a group of students, or selected lectures of a course already offered. As topics may be changed, the course may be repeated for credit.

**FOOD 498 Undergraduate Teaching Experience**

Fall or spring. 3 credits maximum.

Prerequisite: permission of instructor. Students must register with an Independent Study form (available in 140 Roberts Hall). S-U grades only.

Students assist in teaching a course appropriate to their previous training. Students will meet with a discussion or laboratory section and will regularly discuss objectives with the course instructor.

**FOOD 499 Undergraduate Research in Food Science**

Fall or spring. 4 credits maximum. S-U grades optional. Students must register with an Independent Study form (available in 140 Roberts Hall).

Students conduct original research directed by a food science faculty member.



**FOOD 600 Seminar**

Fall or spring. 1 credit. Required of all food science graduate students. S-U grades only. T 4:30-5:20.

**FOOD 604 Chemistry of Dairy Products**

Fall. 2 credits. Limited to 16 students. Prerequisites: organic chemistry, biochemistry, knowledge of dairy-product manufacturing procedures, and permission of instructor. Offered alternate years. Not offered 1997-98; next offered fall 1996 and 1998. F 1:25-3:30. D. M. Barbano.

A detailed study of milk constituents and their properties. Properties of various milk constituents are related to observed physical and chemical changes that occur in dairy products during and after processing. This course will emphasize current research in dairy chemistry.

**FOOD 605 Physical Chemistry of Food Components**

Fall. 3 credits. Prerequisite: an undergraduate course in physical chemistry. Offered alternate years. Not offered 1997-98; next offered fall 1996 and 1998. M W F 10:10. J. W. Brady.

This course will cover the physical properties of food molecules. Emphasis will be placed on the molecular basis of structural characteristics; colloidal properties; molecular interactions; foams, gels; and water binding of foods.

**[FOOD 607 Advanced Food Microbiology**

Spring. 2 credits. Prerequisites: food microbiology, genetics (preferred). Offered alternate years. Not offered 1996-97; next offered spring 1998 and 2000. M W 11:15. C. A. Batt.

There have been great advances in applying the modern tools of molecular biology to the detection of microorganisms and their metabolites. The primary emphasis of this course will be to review the recent developments in the theory and application of nucleic acid and antibody-based detection systems, especially as they concern food safety. In addition, other approaches, including measurement of impedance, ATP, and endotoxins, will be discussed.]

**FOOD 612 Electroanalytical Chemistry**

Fall. 2 credits. T 12:20-2:15. R. A. Durst. A descriptive, largely non-mathematical course, focusing on electrochemical principles and methods, will provide a basic survey of the instrumentation, applications, advantages and limitations of the diverse arsenal of potentiometric and amperometric methods of analysis. Applications to analytical problems in environmental and food science will be emphasized.

**FOOD 616 Flavors—Analysis and Applications**

Spring. 2 credits. S-U grades optional. Offered alternate years. Not offered 1997-98; next offered spring 1997 and 1999. Lec, F 1:25; disc, F 2:30. H. T. Lawless and T. E. Acree.

An advanced course in sensory and instrumental analysis of flavors, flavor chemistry, and flavor applications in foods for food scientists and those in related fields concerned with human food perception and consumption. The course will survey taste, aroma and volatile flavors, and trigeminal stimuli from the perspectives of chemical structures, methods of analysis, uses and interactions in food systems, and consumer acceptance.

**[FOOD 620 Food Carbohydrates (also Nutritional Sciences 620)**

Spring. 2 credits. Limited to qualified seniors and graduate students. Prerequisite: BIOBM 330 or equivalent. Offered alternate years. Not offered 1996-97; next offered spring 1998 and 2000. T R 10:10. B. A. Lewis and J. W. Brady.

A consideration of the chemistry of carbohydrates, including sugars, starches, pectins, hemicelluloses, gums, and other complex carbohydrates. Emphasis is on the intrinsic chemistry and functionality in food systems and the changes occurring during food processing and storage.]

**[FOOD 665 Engineering Properties of Foods**

Spring. 2 credits. Prerequisite: course in transport processes or unit operations as applied to foods; or permission of instructor. Offered alternate years. Not offered 1996-97; next offered spring 1998. T R 12:20-1:10. S. S. H. Rizvi and S. J. Mulvaney.

Theories and methods of measurement and prediction of rheological, thermal, and mass transport properties of foods and biomaterial systems. Emphasis is on physical-mathematical basis of measurement as well as the prediction processes. Examples of appropriate use of these properties in engineering design and analysis of food processes will also be provided.]

**FOOD 694 Special Topics in Food Science**

Fall or spring. 4 credits maximum. S-U grades optional. Staff.

The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

**FOOD 698 Graduate Teaching Experience**

Fall or spring. 1 to 3 credits. S-U grades only. Staff.

Designed to give graduate students teaching experience through involvement in planning and teaching courses under the supervision of field faculty members. The experience may include leading discussion sections; preparing, assisting in, or teaching lectures and laboratories; and tutoring. There will be assigned readings and discussion sessions on educational theory and practice throughout the term.

**FOOD 800 Masters-Level Thesis Research**

Fall or spring. Credit to be arranged. Maximum credit, 12. Prerequisite: limited to master's candidates; permission of Special Committee Chair. S-U grades only. Graduate faculty.

**FOOD 900 Graduate-Level Thesis Research**

Fall or spring. Credit to be arranged. Maximum credit, 12. Prerequisite: limited to doctoral students who have not passed the "A" exam; permission of Special Committee Chair. S-U grades only. Graduate faculty.

**FOOD 901 Doctoral-Level Thesis Research**

Fall or spring. Credit to be arranged. Maximum credit, 12. Prerequisite: limited

to doctoral students who have passed the "A" exam; permission of Special Committee Chair. S-U grades only. Graduate faculty.

**Related Courses in Other Departments**

Introduction to Computing (ABEN 151)

Food Process Engineering: A Transport Phenomena Approach (ABEN 466)

Marketing (ARME 240)

Food Industry Management (ARME 443)

**FREEHAND DRAWING AND SCIENTIFIC ILLUSTRATION**

Freehand Drawing is a program within the Department of Floriculture and Ornamental Horticulture. Other courses offered by the department are listed under Horticultural Sciences and Landscape Architecture.

**FR DR 109 Nature Drawing**

Fall. 3 credits. Limited to 25 students. S-U grades optional. Permission of instructor required. M W F 10:10-12:05. R. J. Lambert.

A beginning course with emphasis on the drawing of natural forms: plants, animals, and landscapes. Of particular interest to students in floriculture and ornamental horticulture, landscape architecture, biological sciences, nature education, or similar fields. Outside field notebook assignments.

**FR DR 210 Sketching in Watercolor**

Summer. 3 credits. S-U grades optional. M T W R F 11:30-12:45. R. J. Lambert.

Practice in outdoor sketching, primarily in watercolor, but including pen and ink, pencil, and colored pencil. Studio will develop working sketches into complete paintings. Principles of perspective are taught and applied. For any student who wishes to develop skill in handling watercolor. Outside-of-class sketchbook work required.

**FR DR 211 Freehand Drawing and Illustration**

Fall. 2 credits. Prerequisite: FR DR 109 or equivalent. S-U grades optional. 6 studio hours scheduled in 2 or 3 hour units between 9:05 and 12:05 M T W R F. R. J. Lambert.

Progression to the organization of complete illustrations. Subject matter largely from sketchbooks, still life, and imagination. Composition, perspective, and ways of rendering in different media are considered.

**FR DR 214 Watercolor**

Spring. 2 credits. Prerequisite: FR DR 109 or equivalent. S-U grades optional. 6 studio hours scheduled in 2 or 3 hour units between 9:05 and 12:05. M T W R F. R. J. Lambert.

A survey of watercolor techniques. Subject matter largely still life, sketchbook, and on-the-spot outdoor painting.

**FR DR 316 Advanced Drawing**

Fall or spring. 2 credits. Prerequisite: FR DR 109, 211 or permission of instructor. S-U grades optional. 6 hours to be arranged. R. J. Lambert.

For students who want to attain proficiency in a particular type of illustration or technique.

**[FR DR 417 Scientific Illustration]**

Fall. 2 credits. Prerequisite: FR DR 211 or 316 or equivalent. S-U grades optional for graduate students only. Not offered 1996-97.

A survey of methods of illustration. Training in techniques of accurate representation in media suitable for reproduction processes, including pen and ink, scratchboard, wash, and mixed media.]

## FRUIT AND VEGETABLE SCIENCE: HORTICULTURAL SCIENCE

See Horticultural Sciences.

## HORTICULTURAL SCIENCES

Horticultural science courses at Cornell are taught by the faculty of the Department of Floriculture and Ornamental Horticulture and the Department of Fruit and Vegetable Science.

### Floriculture and Ornamental Horticulture

G. L. Good, chair; M. I. Adleman, N. L. Bassuk, S. Baugher, C. F. Gortzig, H. W. Gottfried, J. Gruttadauria, P. H. Horrigan, D. W. Krall, R. J. Lambert, R. W. Langhans, L. J. Mirin, R. G. Mower, K. W. Mudge, J. C. Neal, A. M. Petrovic, D. A. Rakow, F. S. Rossi, D. J. Tennesen, R. T. Trancik, P. J. Trowbridge, T. C. Weiler, T. H. Whitlow

### Fruit and Vegetable Science

H. C. Wien, chair; R. R. Bellinder, L. L. Creasy, L. A. Ellerbrock, D. E. Halseth, J. R. Hicks, I. A. Merwin, M. P. Pritts, J. Sieczka, W. C. Stiles, L. D. Topoleski, C. B. Watkins, D. W. Wolfe

### Courses by Subject:

General horticulture: 101, 102

Crop production:

Agroforestry: 415

Controlled Environment Agriculture: 410, 411, 412, 413

Fruit: 200, 442, 444, 445, 450

Greenhouse: 410, 411, 412, 413

Nursery: 400, 420

Turfgrass: 330, 475

Vegetable: 225, 456, 460

Extension education: 629

Horticultural physiology: 400, 450, 455, 456, 460, 462, 615, 620

Independent study, research, and teaching: 470, 495, 496, 497, 498, 499, 500, 605, 700, 800, 900

Internships: 496

Landscape architecture (professionally accredited program)

Landscape horticulture: 435, 440, 491

Landscape architecture: 141, 142, 261, 282, 315, 316, 317, 318, 360, 363, 410, 412, 480, 483, 486, 487, 496

Plant materials: 230, 243, 300, 301, 335, 430

Plant propagation: 400

Postharvest physiology: 325, 625, 630

Sales and service businesses: 425

Seminars: 495, 602, 630, 636

Special topics: 470, 494, 629, 630, 635, 694

Turfgrass management: 330, 475

Vegetable types and varieties: 220, 465

**Note:** class meeting times are accurate at the time of publication. If changes are necessary, the department will provide new information as soon as possible.

### HORT 101 Introduction to Horticultural Science

Fall. 4 credits. Lec, M W F 10:10; lab W 1:25-4:25. C. F. Gortzig.

An introduction to horticulture in all of its components: floriculture, nursery, landscape horticulture, turfgrass management, fruit and vegetable science, urban horticulture, and related professional and commercial fields. A survey of the component fields of plant science also is provided. Emphasis is on the history, geography, and literature of the field; the structure and organization of the component industries, institutions, and professions; and the role of science and technology in the continuing development of horticultural practice. Field trips, including one three-day field trip (cost approximately \$130.00), are taken to horticultural firms, institutions, and historic sites.

### HORT 102 General Horticulture

Spring. 4 credits. Each lab limited to 25 students. Lec, M W F 10:10; lab M T or W 2-4:25. L. D. Topoleski.

Acquaints the student with applied and basic horticulture. Open to all students who want a general knowledge of the subject or who want to specialize in horticulture but have a limited background in practical experience or training in plant science. Includes flower, fruit, and vegetable growing and gardening techniques.

### HORT 200 Introductory Pomology

Fall. 3 credits. S-U grades optional. Lec, T R 10:10; lab, T 1:25-4:25. I. A. Merwin.

A survey of fruit science, emphasizing the natural history, botany, physiology, and production of edible fruits in temperate-climate areas. Topics include varietal breeding and propagation, environmental and sustainability issues, and practical methods of fruit production. Labs and field trips will provide hands-on experience and tours of regional orchards.

### HORT 220 Vegetable Types and Identification

Fall. 2 credits. T 2-4:25. L. Topoleski.

Acquaints students with the vegetable species grown in the Northeast and the pests and disorders encountered in their production. Subjects covered include identification of economically destructive weeds, diseases and insects of vegetables, identification of vegetable and weed seeds, seedlings, nutrient deficiencies, vegetable judging, grading, and grade defects.

### HORT 225 Vegetable Production

Fall. 4 credits. Lec, M W F 11:15; lab, W 2-4:25; 1 S fieldtrip and 3 fieldtrips (Stepember). W 11:15-6:00. L. A. Ellerbrock.

Intended for those interested in the production, processing, and marketing of vegetables. Topics included are techniques, problems, and trends in the culture, harvesting and storage of the major vegetable crops. Field trips to conventional and organic farms and hands-on experience in growing vegetables in the laboratory are included.

### HORT 230 Woody Plant Materials

Spring. 4 credits. Fee for lecture-laboratory manual: \$35. Lec, T R 9:05; lab T 2-4:25 required and either W or F 2-4:25. R. G. Mower.

A study of the trees, shrubs, ground covers, and vines used in landscape plantings. Emphasis is on winter identification and values for use as landscape material.

### HORT 243 Taxonomy of Cultivated Plants (also BIOPL 243)

Fall. 3 credits. Prerequisite: One year of introductory biology or written permission of instructor. May not be taken for credit after BIOPL 248. Offered 1996-97; next offered 1998-99. Lec, M W 10:10-11:00; lab, W 2-4:25. M. A. Luckow.

A study of ferns and seed plants, their relationships, and their classification into families and genera, emphasizing cultivated plants. Particular emphasis is placed on gaining proficiency in identifying and distinguishing families and in preparing and using analytic keys. Attention is also given to the economic importance of taxa, to the basic taxonomic literature, and to the elements of nomenclature.

### HORT 300 Garden and Interior Plants I

Fall. 3 credits. Fee for lecture-laboratory manual: \$35. Lec, T R 10:10; lab, T 2-4:25. R. G. Mower.

A study of ornamental plants used in garden and interior situations. The first seven weeks cover primarily herbaceous annuals and perennials, with the laboratory devoted to various practical gardening activities. The remainder of the semester covers the major kinds of foliage and flowering plants used in the home and in other interior landscape situations. Emphasis is on identification, use, and general cultural requirements.

### HORT 301 Garden and Interior Plants II

Spring. 3 credits. Prerequisite: HORT 300 or permission of instructor. Fee for lecture-laboratory manual: \$35. Lec, M W 11:15; lab, M 2-4:25. R. G. Mower.

A continuation of Horticultural Sciences 300. The first seven weeks are devoted to a further study of interior plants, with emphasis on specialized groups of interior plants such as orchids, cacti and succulents, gesneriads, ferns, palms, and bromeliads. The second seven weeks are devoted to outdoor herbaceous plants, such as tulips, daffodils, crocuses, and irises, as well as other spring-blooming bulbs and perennial plants. Outdoor laboratories emphasize practical gardening activities appropriate to the spring season.

### [HORT 325 Practical Aspects of Postharvest Handling of Horticultural Crops]

Spring. 3 credits. Offered alternate years. Not offered spring 1997. Lec, M W 9:05; lab T 1:25-4:25. J. R. Hicks.

A study of changes that occur in horticultural crops between harvest and consumer. Practices that affect the rate of change and the final effect on quality of the commodity are discussed. Maturity/quality indices, preharvest treatments, and harvesting/handling practices and storage/transportation requirements of selected horticulture crops are covered.]

**HORT 330 Turfgrass Management**

Fall. 3 credits. Prerequisite: SCAS 260.  
Offered fall 1996; next offered 1998-99.  
Lec, M W 11:15; lab, F 11:15-1:10.  
A. M. Petrovic.

Study of the scientific principles involved in the management of golf courses, athletic fields, parks and industrial grounds, and commercial sod production. Considerations given to principles of establishment, mowing, irrigation, growth and development, species selection, and nutrition in the management of turfgrass sites.

**HORT 335 Woody Plant Materials for Landscape Use**

Fall. 3 credits. Limited to 30 students.  
Primarily for landscape architecture majors.  
Fee for lecture-laboratory manual, \$35.  
Lecs, M W 9:05; lab R 1:25-4:25.  
R. G. Mower.

A study of the trees, shrubs, vines, and ground covers used in landscape plantings in the northeastern United States. Emphasis is on leaf identification and on characteristics that determine the usefulness of each as landscape subjects.

**HORT 400 Principles of Plant Propagation**

Fall. 3 credits. Prerequisites: BIOPL 242 and 244 or another course in plant physiology. Lec, T R 9:05; lab, R 1:25-4:25. K. W. Mudge.

Sexual (seed) propagation and asexual (vegetative) propagation including cuttage, graftage, tissue culture, layering and specialized vegetative reproductive structure. Physiological, environmental, and anatomical principles are stressed in lecture and hands-on experience in laboratories. Examples include both temperate as well as tropical horticulture, agronomic, and forestry crops.

**HORT 410 Principles of Controlled Environment Agriculture (CEA)**

Spring. 3 credits. Prerequisite: permission of instructor. Letter grade only.  
3-day field trip required. Cost of field trip: \$80+. Lec, T R 10:10-12:05. T. C. Weiler and staff.

Basics and issues related to managing agricultural production in environmentally optimized facilities. Survey of CEA as an agricultural alternative, technology basics, systems and practices; world centers of production, structures, systems and equipment, materials handling, heating and cooling, lighting, fertilizing and irrigation, environmental stewardship, integrated pest management, business management, and human resource management.

**HORT 411 Principles of Crop Production in Controlled Environments**

Spring. 3 credits. Prerequisites or corequisite: HORT 410. Letter grade only.  
Two afternoon field trips required. Lec, W F 8:00; lab R 2-4:25. T. C. Weiler.

Study of several controlled-environment agriculture (CEA) crops; including cut, pot and bedding ornamentals; vegetables and fruits briefly covered; emphasis on predictive harvesting through environmental, physical, and chemical management of growth and development. Each student will grow one or more crops.

**HORT 412 Case Studies of Controlled Environment Agriculture (CEA)**

Spring. 1 credit. Prerequisite or corequisite: HORT 410. Lab 3 hours per week as scheduled. R. W. Langhans, J. D. Novak and G. R. White.

Analysis of actual CEA enterprises regarding adoption of technology, crop culture, operations management, and/or marketing.

**HORT 413 Computer-Assisted Management in Controlled Environment Agriculture (CEA)**

Spring. 1 credit. Prerequisite or corequisite: HORT 410. Lab 3 hours per week as scheduled. R. W. Langhans.

Application of computer software to operations management and environmental management of a CEA facility—including specifications for facilities, optimization of resource inputs (e.g., energy, fertilizer), crop programming, efficient space use, labor efficiency (time and motion), and inventory management.

**HORT 415 Principles and Practices of Agroforestry (also NTRES 415)**

Spring. 2 credits. Prerequisites: senior or graduate standing or permission of instructor. S-U option. Lec, W 10:10; lab, 1:25-4:25. K. W. Mudge, J. P. Lassoie.

An introduction to modern and traditional agroforestry systems involving the spatial or temporal integration of multipurpose woody plants (trees and/or shrubs) with annual or perennial crops and/or with livestock. Interactions between woody and non-woody components of agroforestry systems will be considered from the standpoint of above and below ground resource capture. The sustainability of agroforestry systems will be critically examined from both a biophysical and socioeconomic perspective. Laboratory sessions will include field trips, case studies, use of computer-based sources of information, and practical skills involved in woody plant management (identification, propagation, planting, pruning, measurement.)

**HORT 420 Principles of Nursery-Crop Production**

Fall. 4 credits. Prerequisite: HORT 400.  
Lecs, M W F 9:05; lab, M 2-4:25. Field trips. G. L. Good.

Principles of commercial production of nursery crops to marketable stage, including postharvest handling and storage. Term project required. Field trips are made to commercial nurseries.

**HORT 425 Horticultural Sales and Service Businesses**

Spring. 4 credits. Fee for course manual \$35. Prerequisites: ARME 240 or permission of instructor. Weekly laboratory field trips to commercial operations and one 3-4-day field trip to a metropolitan area (cost approximately \$130.00) are taken. Lec, M W F 10:10; lab, W 1:25-4:25. C. F. Gortzig.

A study of the application of horticultural, marketing, and management principles and practices in the operation of horticultural sales and service firms, e.g., garden centers, retail florist and nursery stores, wholesale marketing operations, mail-order businesses, mass markets, interior and outdoor landscape-service and related firms.

**HORT 430 Special Topics in Ornamental Plants**

Fall or spring. Credit and hours to be arranged. Primarily for upperclass floriculture and ornamental horticulture majors. Prerequisites: HORT 230, 300, 301, 335, or the equivalent, and permission of instructor. R. W. Mower.

Topical subjects in plant materials. Independent and group study of important groups of woody and herbaceous plant materials not considered in other courses. The topic is given in the supplementary announcement.

**[HORT 435 Landscape Management**

Fall. 4 credits. Prerequisites: HORT 230 or 335, and BIO PL 241 or permission of instructor. Not offered 1996-97. Lec, M W F 12:20; lab, T 1:25-4:25.

A study of the practices involved in the planting and maintenance of woody ornamental plants in the landscape. The major emphases will be on planting and post-planting techniques, water and fertilization management, pruning, and general tree care. The lectures will focus on the physiological bases for essential management principles. Labs have a hands-on focus.]

**[HORT 440 Restoration Ecology**

Fall. Offered odd years; next offered 1997. Weeks 1-10. 3 credits. Prerequisite: upper division or graduate standing. Letter grade only. Lec, T R 10:10; lab, F 1:25-4:25. T. H. Whitlow.

An inquiry based treatment of the principles and methods of ecology, conservation biology, hydrology, soil science and related disciplines applied to the restoration of degraded terrestrial ecosystems. Weekly labs, four weekend field trips, and a semester-long project provide many opportunities for experiential learning. Substantial commitment outside of the classroom is expected.]

**HORT 442 Berry Crops: Culture and Management**

Fall. 3 credits. Offered even years. Lec, M W 9:05; lab, M 1:25-4:25. M. P. Pritts.

A study of the evolution, breeding history, and physiology of strawberries, raspberries, blackberries, blueberries, and other minor small fruit crops, and of cultural practices that influence productivity, fruit quality, and pest damage. Marketing and economics will be considered, and alternative production practices for both commercial and home gardeners will be discussed. Frequent field trips enhance classroom activities.

**[HORT 444 Applied Viticulture**

Fall. 3 credits. Not offered fall 1996.  
Lecs, T R 9:05; lab, R 2-4:25. L. L. Creasy.

Grape production and post-production practices with emphasis on the Great Lakes and Finger Lakes regions. We will examine grape varieties, site selection, and vine management as affected by geography, meteorology and vine anatomy/physiology. Protection of vines and grapes from injury by cultural, chemical, and natural means will also be explored. Laboratory exercises and field trips offer hands-on experience in vineyard practices, marketing and processing.]

**HORT 445 Orchard Management**

Spring. 3 credits. Prerequisite: HORT 200. S-U grades optional. Offered even years. Not offered 1997. Lec, T R 10:10; lab T 1:25-4:25. I. A. Merwin.

The science of tree fruit production in temperate climates, including site evaluation and improvement, fruit variety and rootstock

selection, tree propagation, planting, pruning, and training systems, the physiology of flowering and fruit development, dormancy and cold hardiness, tree nutrition and water relations, fruit harvesting and storage, and integrated pest management. Emphasis is on agroecological principles and hands-on practice in orchard lab-sessions and field trips.

**[HORT 450 Soil Management and Nutrition of Perennial Crops]**

Fall. 3 credits. Not offered 1996. Lects, M W 8; lab, M 1:25-4:25. W. C. Stiles.

Fundamentals of mineral nutrition and soil management for perennial horticultural crops. Mineral nutrition aspects deal with diagnostic techniques, interpretation of tissue and soil analyses, and nutrient requirements for optimizing crop performance. Soil management effects on crop performance, nutrient relationships, and interaction with other components of crop production systems are emphasized.]

**[HORT 455 Fertility Management and Nutrition of Vegetable Crops]**

Fall. 3 credits. Prerequisite: any college-level chemistry course. Lects, M W 10:10; lab/disc, M 2-4:25. Not offered fall 1996.

The course deals with both major, secondary and minor elements including fertilization programs, interpretation of tissue and soil analyses, nutrient interactions, induced deficiencies, toxicities as well as the effects of organic matter, crop residues, and specific crop sequences. The course emphasizes hands-on field and greenhouse experiments and small group discussions.]

**HORT 460 Plant-Plant Interactions**

Spring, weeks 1-6. 2 credits. Prerequisite: any crop production course or permission of instructor. Lects, M W F 10:10; lab, M 2-4:25; disc, R or F 1, 2, or 3 (1 hr.). H. C. Wien.

The manner in which plants interfere or positively interact is examined for the management of cropping systems. Competitive and chemical interactions are considered between weeds and crops, among crops in polyculture, and between individuals in monoculture. Examples will be taken from both temperate and tropical monoculture and intercropping systems.

**HORT 462 Vegetable Crop Physiology**

Spring, weeks 7-14. 3 credits. Prerequisites: HORT 225 and BIOL 242. Lects, M W F 10:10; lab, M 2-4:25; disc, R or F 1, 2, or 3 (1 hr.). H. C. Wien.

Study of the physiological processes that determine the timing, quantity, and quality of vegetable crop yield. Processes of flower induction, fruit set, fruit growth, and the relations between vegetative and reproductive growth are covered. The course emphasizes practical hands-on greenhouse experiments and weekly small-group discussions.

**[HORT 465 Vegetable Varieties and Their Evaluation]**

Fall, weeks 1-7. 2 credits. Prerequisites: HORT 225 or permission of instructor. S-U grades only. Lects, W F 8; lab, F 1:25-4:25. Not offered fall 1996. D. W. Wolfe and H. C. Wien.

Principles of vegetable variety evaluation and selection of techniques in relation to program objectives. Morphology, yield, and quality of selected crops will be studied in the field. The seed industry will be briefly discussed.]

**HORT 470 Special Topics in Pomology**

Spring. 3 credits. Open to undergraduates by permission. Hours to be arranged. Staff.

Selected topics are considered with respect to the current literature, experimental techniques, or applied technologies. Topics change from one year to another and reflect the expertise and research interests of the professors who participate. Topics selected for each term will be announced several months before the term begins.

**[HORT 475 Golf Course Management]**

Fall. 2 credits. Prerequisite: HORT 330 or equivalent. Offered odd years; fall 1997, fall 1999. Lects to be arranged. A. M. Petrovic.

Advanced study in the management of golf course operations including selection of root zone materials, fertilization practices, integrated pest management practices, irrigation systems, environmental based decision making, personnel management and financial operations. Analysis of a central New York golf course will provide the basis for discussion.]

**HORT 491 Planting Design and Establishment (also LA 491)**

Fall. 3 credits. Prerequisites: HORT 230 or 335 or permission of instructor. Lects, T R 12:20; studio, R 1:25-4:25.

N. L. Bassuk and P. J. Trowbridge.

This course will focus on the establishment of woody and herbaceous plants in urban and garden settings. By understanding the environmental constraints placed on plants, we will be able to critically assess and modify potential planting sites, select appropriate trees, shrubs, and ground covers for a given site, and learn about the principles and practices of plant establishment both in the ground and in contained environments. Design followed by specifications and graphic details will be produced to implement these practices. Field work includes chemical and physical analysis of soils, vegetation, and site assessment.

**HORT 494 Special Topics in Horticulture**

Fall or spring. 4 credits maximum. S-U grades optional. Hours to be arranged.

**Section 01**, fruit and vegetable science; **Section 02** floriculture. Staff.

The departments teach "trial" courses under this number. Offerings vary by semester, and will be advertised by the departments. Courses offered under the number will be approved by the department curriculum committees, and the same course will not be offered more than twice under this number.

**HORT 495 Undergraduate Seminar**

Undergraduate participation in weekly departmental seminar series. May be taken four times for one credit per semester. S-U grades only.

**Section 01:** Current topics in Fruit and Vegetable Science (see HORT 602).

Fall or spring. 1 credit. R4. I. A. Merwin. Graduate students should enroll in HORT 602.

**Section 02:** Current topics in Floriculture and Ornamental Horticulture.

Fall. 1 credit. R 12:20. T. C. Weiler. Graduate students in Floriculture and Ornamental Horticulture should enroll in HORT 636 (Section 02).

**HORT 496 Internship in Horticultural Sciences**

Fall or spring. Credit variable. S-U grades optional. Prerequisite: permission of student's adviser **in advance of participation** in internship programs. Students must register with an Independent Study form (available in 140 Roberts Hall) signed by the faculty member who will supervise their study and assign their grade. Hours to be arranged. Staff.

**HORT 497 Independent Study in Horticultural Sciences**

Fall or spring. Credit variable. S-U grades optional. Prerequisite: permission of instructor(s). Students must register with an Independent Study form (available in 140 Roberts Hall.) Independent study in horticultural sciences under the direction of one or more faculty members. Hours to be arranged. Staff.

**HORT 498 Undergraduate Teaching Experience**

Fall or spring. Credit variable. S-U grades optional. Prerequisites: previous enrollment in course to be taught or equivalent, and written permission of the instructor. Students must register with an Independent Study form (available in 140 Roberts Hall.) Hours to be arranged. Staff.

Designed to give qualified undergraduate students teaching experience through actual involvement in planning and teaching horticultural sciences courses under the supervision of departmental faculty members. This experience may include leading discussion sections; preparing, assisting in, or teaching laboratories; and tutoring.

**HORT 499 Undergraduate Research**

Fall or spring. Credit variable. S-U grades optional. Prerequisite: permission of instructor. Students must register with an Independent Study form (available in 140 Roberts Hall.) Hours to be arranged. Staff.

Undergraduate research projects in horticultural sciences.

**HORT 500 Master of Professional Studies (Agriculture) Project**

Fall or spring. 1-6 credits. (6 credits maximum toward MPS [Agriculture] degree). S-U grades optional. Staff.

A comprehensive project emphasizing the application of principles and practices to professional horticultural teaching, extension, and research programs and situations. Required of Masters of Professional Studies (Agriculture) candidates in the respective graduate fields of horticulture.

**HORT 600 Professional Colloquium Series/FOH**

Spring. 1 credit. Prerequisite: Primarily for graduate students in final year of studies; written permission from instructor required for undergraduates. Lec, M 12:20. D. J. Tennesen.

Graduate students join distinguished visitors and Cornell staff members for weekly professional seminars on current teaching, research, and extension in floriculture and ornamental horticulture. Students will present a seminar based on their work. Often students use the presentations as part of their thesis defense and in preparation for job interviews.



**HORT 602 Seminar in Fruit and Vegetable Science**

Fall or spring. 1 credit. S-U grades only. R 4:00. I. A. Merwin.

Weekly seminars consist of graduate student research project reports, faculty research topics, as well as guest speakers from other universities and/or industry. Required of graduate students majoring or minoring in pomology or vegetable crops. Undergraduate students register under HORT 495 Sec 1.

**HORT 615 Quantitative Methods in Horticultural Research**

Spring. Weeks 1-9. 2 credits. Prerequisite: BTRY 601, BTRY 602 or permission of instructor. S-U grades only. T R 2:30-4:25. D. W. Wolfe.

Advantages and limitations of conventional experimental designs and analyses of greenhouse and field (including on-farm) experiments. Use and interpretation of plant growth analysis techniques. Discussions will include critical analysis of published data and research in progress.

**HORT 620 Woody Plant Physiology**

Spring. 4 credits. BIOPL, BIOBM 331, CHEM 357, or equivalent, or permission of instructor. Offered spring 1997. Letter grade only. Lects, T R 8:40-9:55. T. H. Whitlow.

A detailed study of physiological processes in woody plants and how these processes influence crop production practices. Topics will include shoot and root growth, phytohormones, dormancy, photoperiodism, photosynthesis, respiration, carbon and nitrogen metabolism, water relations, and fruiting. Several faculty members participate in teaching.

**[HORT 625 Advanced Postharvest Physiology of Horticultural Crops**

Spring. 3 credits. Prerequisite: BIOPL 242 and/or HORT 325. Offered alternate years. Not offered spring 1997. Lects, T R 10:10; disc, to be arranged. P. M. Ludford.

Physiological and biochemical aspects of growth and maturation, ripening, and senescence of harvested horticultural plant parts. Topics include morphological and compositional changes during ripening and storage life, some physiological disorders, aspects of hormone action and interactions, and a consideration of control.]

**HORT 629 Special Topics in Plant Science Extension (also Plant Breeding 629)**

Spring. 2 credits. Offered alternate years. F 1:25-4:25. W. D. Pardee.

Designed for graduate students and advanced undergraduates to provide a broader knowledge of cooperative extension philosophy and methods. Developed for students interested in extension and research in public and commercial organizations. Topics relate to extension in other countries as well as in the United States.

**HORT 630 Current Topics in Postharvest Horticulture**

Spring. 1 credit. Prerequisite: permission of instructor. Hours to be arranged. Staff. Graduate students and staff report and discuss current topics in postharvest biology and technology of horticultural crops.

**HORT 635 Tools for Thought**

Fall. 1 credit. Open to graduate students only. S-U grade only. 1 hour per week, to be arranged. T. H. Whitlow.

A survey of the philosophy of science, hypothesis testing, approaches to experimental design, experimental hierarchies, methods of data reduction, the interaction between basic and applied research and the role of reductionism in the applied plant sciences. This course is intended to assist newer graduate students make the intellectual transition from taking proscribed courses to conducting independent original research. Readings include Kuhn's *The Structure of Scientific Revolutions*. Discussion and critiques of assigned readings.

**HORT 636 Current Topics in Horticulture**

1 credit. S-U grades only.

**Section 01:** Fruit and Vegetable Science. Staff. Fall or spring. 1 hour per week, to be arranged. A seminar series on current topics chosen by participating students and faculty, on a rotating basis. Format consists of weekly discussion groups, with each participant presenting at least one oral report based on independent reading and/or experimentation relating to the chosen topic. Interested students should contact the designated instructor(s) for each term.

**Section 02:** Floriculture and Ornamental Horticulture. T. C. Weiler and staff. Fall. 1 hour per week, to be arranged. Graduate students only. Undergraduates should enroll in HORT 495 (Section 02). Each week a staff member will develop a dialogue with students on a topic of current mutual interest. Topics and discussion leaders change by week and semester; topics will encompass planting design, exterior and interior landscape management, turfgrass management, urban horticulture, nursery management, plant materials, stress physiology, weed science, root zone ecology, horticultural sales and service business operation, and controlled environment agriculture. Brief reading assignments may be distributed for completion by the next class.

**HORT 694 Special Topics in Horticulture**

Fall or spring. 4 credits maximum. S-U grades optional. Hours to be arranged.

Sec 01, Floriculture. Sec 02, Fruit and Vegetable Science. Staff.

The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department. Courses offered under the number will be approved by the department curriculum committees, and the same course will not be offered more than twice under this number.

**HORT 700 Graduate Teaching Experience**

Fall or spring. Credit variable. Open only to graduate students. Undergraduates should enroll in HORT 498. S-U grades optional. Prerequisite: permission of instructor. Hours to be arranged. Staff. Designed to give graduate students teaching experience through involvement in planning and teaching courses under the supervision of departmental faculty members. The experience may include leading discussion sections, preparing, assisting in, or teaching lectures and laboratories; and tutoring.

**HORT 800 Thesis Research, Master of Science**

Fall or spring. Credit to be arranged. S-U grades only.

**HORT 900 Thesis Research, Doctor of Philosophy**

Fall or spring. Credit to be arranged. S-U grades only.

## INTERNATIONAL AGRICULTURE

**Note:** class meeting times are accurate at the time of publication. If changes are necessary, the department will provide new information as soon as possible.

**INTAG 300 Perspectives in International Agriculture and Rural Development**

Fall. 2 credits. F 1:25-3:20. E. Erickson.

A forum to discuss both contemporary and future world food issues and the need for an integrated, multidisciplinary team approach in helping farmers and rural development planners adjust to the ever-changing food needs of the world.

**INTAG 402 Agriculture in Tropical America**

Fall. 2 credits. Prerequisite: Upper class or graduate standing. F 1:25-3:20.

H. D. Thurston and staff.

A preparatory course for participation in International Agriculture 602. Physical resources, vegetation, history, crop and animal production, and various social and economic aspects of agriculture in tropical America will be discussed.

**INTAG 403 Traditional Agriculture in Developing Countries**

Fall. 1 credit. S-U only. T 8-8:50.

H. D. Thurston, D. Bates, R. Blake, J. Lassoie, A. Power, E. Fernandez, T. Steenhuis.

Today, perhaps over half of the world's arable land is farmed by traditional farmers. They developed sustainable agriculture practices which allowed them to produce food and fiber for millennia with few outside inputs. Many of these practices have been forgotten in developed countries but are still used by many traditional, subsistence, or partially subsistence farmers in developing countries. The course will examine traditional systems from several disciplinary points of view.

**INTAG 414 Cultivation and Improvement of Cereal Crops**

Spring. 1 credit. Prerequisite: An introductory biology or crops course (BIO G 101, HORT 102, SCAS 311 or equivalent) and SCAS/BIO G 473. Offered alternate years. Not offered 1997-98; next offered 1996-97 and 1998-99. M W F 11:15. M. E. Smith and staff.

An introduction to characteristics, culture, and improvement of important cereal crops of the tropics and subtropics, including agronomic, economic, and social aspects. Emphasizes maize and rice. Lectures feature slides and other illustrative material based on experiences in the tropics and discussion of current issues relating to tropical cereal crops. This is the first of three 1-credit modules, including INTAG 416 and INTAG 418, each taught for one-third of the semester.

**INTAG 416 Cultivation and Improvement of Root, Tuber, and Plantain Crops**

Spring. 1 credit. Prerequisite: An introductory biology or crops course (BIO G 101, HORT 102, SCAS 311, or equivalent) and SCAS/BIO G 473. Offered alternate years. Not offered 1997-98; next offered 1996-97 and 1998-99. M W F 10:10. Staff.

An introduction to tropical root, tuber, and plantain crops, their importance, their culture, and their food, feed, and industrial uses. The cultural and socio-economic role of these crops in tropical societies will be considered, as well as the negative and positive aspects of their production and utilization. This is one of three 1-credit modules, including INTAG 414 and INTAG 418, each taught for one-third of the semester.

#### **INTAG 418 Horticultural Crops in the Tropics**

Spring. 1 credit. Prerequisite: An introductory biology or crops course (BIO G 101, HORT 102, SCAS 311 or equivalent) and SCAS/BIO G 473. Offered alternate years. Not offered 1997-98; next offered 1996-97 and 1998-99. M W F 11:15.

I. Merwin, E. Figueroa, and C. Wien.

A survey of fruit and vegetable crops of economic and/or dietary importance in the tropics. The natural history of horticultural crops, major regions and methods of production, domestic and export marketing systems, and various technological, ecological, and social factors that affect tropical fruit and vegetable production will be emphasized. This is one of three 1-credit modules, including INTAG 414 and INTAG 416, each taught for one-third of the semester.

#### **INTAG 599 International Agriculture and Rural Development Project Paper**

Fall and spring. 1-6 credits. Limited to M.P.S. candidates in the fields of International Agriculture and Rural Development (IARD) and International Development (ID). S-U grades only. Staff.

#### **INTAG 602 Agriculture in the Developing Nations**

Spring. 3 credits. Prerequisites: INTAG 300 or equivalent, INTAG 402, and permission of instructors. Cost of field-study trip includes air fare and approximately \$450 for lodging, meals, and personal expenses. T R 2:30-4:25 until midterm only. R. W. Blake and staff.

Oriented to provide students an opportunity to observe agricultural development in a tropical environment and promote interdisciplinary exchange among staff and students. The two-week field-study trip during January to Latin American countries is followed by discussions and assignments dealing with problems in agriculture and livestock production in the context of social and economic conditions.

#### **INTAG 603 Administration of Agricultural and Rural Development (also Government 692)**

Spring. 4 credits. M 2:30-5:00. N. T. Uphoff and staff.

An intercollege course designed to provide graduate students with a multidisciplinary perspective on the administration of agricultural and rural development activities in developing countries. The course is oriented to students trained in agricultural or social sciences who are likely to have administrative responsibilities during their professional careers.

#### **INTAG 650 Special Topics in International Agricultural and Rural Development**

Fall or spring. 1-3 credits. Staff. A seminar for new themes of agricultural and rural development. Offered occasionally. Specific content varies.

#### **INTAG 685 Training and Development: Theory and Practice (also Communication 685, Education 685 and Industrial and Labor Relations 658)**

Spring and summer. 4 credits. S-U grades optional. Charge for materials \$45. Lec, F 9:05-12:05; lab, 1 hour per week, to be arranged. At Communication Graduate Center. R. Colle, M. Ewert, D. Deshler.

Analysis, design, and administration of training programs for the development of human resources in small-farm agriculture, rural health and nutrition, literacy as nonformal education, and general community development. Designed for scientists, administrators, educator-trainers, and social organizers in rural and agricultural development programs in the U.S. and abroad.

#### **INTAG 703 Seminar for Special Projects in Agricultural and Rural Development**

Fall and spring. 1 credit. Required for graduate students enrolled in the M.P.S. (Agr.) degree program and majoring in international agricultural and rural development; others with permission of the program director. S-U grades only. M 12:20-2:15. R. W. Blake and staff.

The seminar provides students with the opportunity to develop and present their special projects. It also serves as a forum for discussion of current issues in low-income agricultural and rural development, with particular attention to interdisciplinary complexities.

#### **Related Courses in Other Departments**

Sociotechnical Aspects of Watershed Development (ABEN 754, ARME 754, and GOVT 644)  
Introduction to Global Economic Issues (ARME 100)  
International Trade Policy (ARME 430)  
Economics of Agricultural Development (ARME 464)

The World's Food (ARME 660)  
[Seminar on Agricultural Trade Policy (ARME 730)  
Not offered 1996-97.]

Macro Policy in Developing Countries (ARME 763)  
Tropical Livestock Production (AN SC 400)  
Tropical Forages (AN SC 403)  
Southeast Asia Seminar: Country Seminar (ASIAN 601 and 602)

Plants and Civilization (BIO PL 246)  
Food, Agriculture, and Society (B&SOC 469, BIO G 469, S&TS 469)

Seminar in International Planning (CRP 671)  
Seminar in Project Planning in Developing Countries (CRP 675)

Intercultural and Development Communication (COMM 612)

Communication in the Developing Nations (COMM 624)

Comparative Studies in Adult Education (EDUC 483)

Planning Educational Systems (EDUC 678)  
Designing Extension and Continuing Education Programs (EDUC 681)

Community Education and Development (EDUC 682)

International Postharvest Food Systems (FOOD 447)

Political Economy of Change: Rural Development in the Third World (GOVT 648)

International Environmental Issues (NTRES 400)  
Religion, Ethics, and the Environment (NTRES 407)  
National and International Food Economics (NS 457)

International Nutrition Problems, Policy, and Programs (NS 680)

International Nutrition Seminar (NS 698)  
Special Topics in International Nutrition (NS 699)  
Introduction to Plant Breeding (PL BR 201)

Plant Diseases in Tropical Agriculture (PL PA 655)  
International Development (R SOC 205)  
Comparative Issues in Social Stratification (R SOC 370)

Gender Relations, Gender Ideologies, and Social Change (R SOC 425)

Social Demography (R SOC 438)

Population, Environment, and Development in Sub-Saharan Africa (R SOC 495)

Contemporary Sociological Theories of Development (R SOC 606)

Land Reform, Old and New (R SOC 643)

Social Movements in Agrarian Society (R SOC 723)

The Political Economy of Policy and Planning in Third World States (R SOC 725)

Tropical Cropping Systems (SCAS 314)

Properties and Appraisal of Soils of the Tropics (SCAS 471)

Ecology of Agricultural Systems (SCAS 473 and BIOES 473)

## **LANDSCAPE ARCHITECTURE**

H. W. Gottfried, Program coordinator;  
M. I. Adleman, S. Baugher, P. H. Horrigan,  
D. W. Krall, L. J. Mirin, R. T. Trancik,  
P. J. Trowbridge, K. A. Wolf

#### **LA 141 Grounding in Landscape Architecture**

Fall. 4 credits. Limited to 25 students. S-U grades optional.

Developing ability in freehand observation drawing. Freehand still life, landscape, figure, and perspective drawing will be included. Weekly sketchbook assignments.

#### **LA 142 Grounding in Landscape Architecture Studio**

Spring. 4 credits. Limited to approximately 20 students; freshman landscape architecture majors or permission of instructor. Cost of basic drafting equipment and supplies, about \$200.

Fundamentals of landscape design applied to residential and other small-scale site-planning projects. Work in the studio introduces course participant to the design process, design principles, construction materials, planting design, and graphics.

#### **LA 201 Medium of the Landscape**

Fall. 6 credits. Limited to landscape architecture majors. Cost of basic drafting equipment and supplies, about \$200; expenses for field trip, about \$250.

This course provides a foundation in design theory, contemporary and historic case studies, two-dimensional pattern design, three dimensional modelling, measured drawing, sketch and constructed representations, concepts in landform and landscape materials including vegetation. Lecture, seminar but primarily studio practice will be used to introduce course participants to skill development necessary for design within the discipline. Theory related to proportion, distance, size, color, light and time will be fundamental to this course. However, life experience, memory and culture will be highly valued.

#### **LA 202 Medium of the Landscape**

Spring. 6 credits. Prerequisite: LA 201 with a grade of C or better. Cost of supplies, about \$200; expenses for field trip, about \$250.

Understanding the role of basic design, design theory, and design languages in landscape architectural projects.

**LA 261 Urban Archaeology (also CRP 261)**

Fall. 3 credits.

Urban archaeologists study American Indian, colonial, and nineteenth-century sites which now lie within the boundaries of modern cities. This course explores how urban centers evolve; what lies beneath today's cities; and how various cultures have altered the urban landscape. Students will participate in a local archaeological excavation.

**LA 262 Laboratory In Landscape Archaeology**

Spring. 3 credits. Prerequisites: LA 261 or CRP261 or permission of instructor.

Various American Indian civilizations and European cultures have all altered the landscape to meet the needs of their cultures. Students will learn how to interpret the American Indian and Euro-American landscapes of specific archaeological sites by identifying and dating artifacts, studying soil samples, and creating site maps.

**LA 282 The American Landscape**

Spring. 3 credits.

An interdisciplinary survey of the cultural history of the American landscape, including perceptions of landscape as expressed in paintings, photographs, and literature. Landscape values, the relation of landscape to culture, landscape use, and the history of regional and national landscapes are general topics, all seen within the context of the history of the environment.

**LA 301 Integration of Realities**

Fall. 6 credits. Prerequisite: LA 202 with a grade of C or better. Cost of supplies, about \$200; expenses for field trip, about \$250.

Course participants will be engaged in the art and science of site-scaled design. This includes gardens, parks, and residential projects, their design and technical solutions.

**LA 302 Integration of Realities**

Spring. 6 credits. Prerequisite: LA 301 with a grade of C or better. Cost of supplies, about \$200; expenses for field trip, about \$250.

**LA 315 Site Engineering I**

Spring (1st seven weeks of semester). 2 credits. Prerequisite: permission of instructor.

Lectures and studio projects focusing on the development of a working knowledge of site grading, earthwork, storm-water management, site irrigation, site layout, and road alignment.

**LA 316 Site Engineering II**

Fall (2nd seven weeks of semester). 2 credits. Prerequisite: LA 315.

Lectures and studio projects dealing with earthwork estimating; storm water management, site surveys, site layout, site irrigation and horizontal and vertical road alignment.

**LA 317 Site Construction I**

Fall (1st seven weeks of semester). 2 credits. Prerequisite: permission of instructor.

The detail design and use of landscape materials, used by landscape architects in project implementation is the focus of this course. The course format includes lectures, field trips, studio problems, and development of technical drawings leading to construction documentation for a wide variety of projects. Students will construct detail material

prototypes and models and have the option of developing computer-generated drawings.

**LA 318 Site Construction II**

Spring (2nd seven weeks of semester). 2 credits. Prerequisite: permission of instructor.

Exploration of construction materials, including specifications, cost estimates, and methods used by landscape architects in project implementation is the focus for this course. The course includes lectures, studio problems, and development of drawings leading to construction documentation for a comprehensive project. Students will develop a site survey and measured drawings as necessary to develop the comprehensive project.

**[LA 360 Pre-Industrial Cities and Towns of North America (also CRP 360)]**

Fall. 3 credits. Not offered 1996-97; next offered 1997-98.

Various American Indian civilizations as well as diverse European cultures have all exerted their influences on the organization of town and city living. Each culture has altered the landscape in their own unique way as they created their own built environments.]

**LA 363/547 American Indians, Planners, and Public Policy (also CRP 363/547)**

Spring. 3 credits.

Decisions made by public agencies and private enterprise too often lead to the flooding, polluting, strip-mining, or other destruction of American Indian reservations, archaeological sites, and burial grounds. The central focus of the course is how to address urban and regional problems without imperiling the cultural survival of minorities.

**LA 401 Advanced Synthesis: Project Design**

Fall. 6 credits. Prerequisite: LA 302 with a grade of C or better. Cost of supplies and reproductions, about \$200; basic expenses for field trips, about \$200.

Site design and construction projects introduced as an evaluation of each student's professional competency in landscape architecture.

**LA 402 Advanced Synthesis: Project Design**

Spring. 6 credits. Prerequisites: completion of LA 401 or the study abroad option with a grade of C or better. Cost of supplies, about \$200; basic expenses for field trip, about \$250.

A sequence of projects introducing students to advanced skills in large-scale urban design, including 3-d computer modeling and digital design media as tools for shaping the form of the city.

**LA 410 Computer Applications In Landscape Architecture**

Fall or spring. 3 credits. Offered to landscape architecture students only. Limited to 15 students.

This course is designed to develop a working knowledge of various computer software applications (Autocad, Landcad, GIS, etc.) with emphasis on Autocad and Landcad. The course will explore other applications relative to land-use planning and the profession of Landscape Architecture.

**LA 412 Professional Practice**

Spring. 1 credit.

Presents the student with a comprehensive understanding of the role of the professional landscape architect and the problems and opportunities one may encounter in an office or other professional situations. Topics discussed include practice diversity, marketing professional services, office and project management, construction management, computers in the profession, and ethics.

**LA 480 Principles of Spatial Design and Aesthetics (also City and Regional Planning 481 and 581)**

Fall. 3 credits.

A lecture course that introduces the spatial and visual design vocabularies of cities. Aesthetic principles and theories of design are investigated for different types of urban spaces drawn from a variety of international examples, historic and modern. Included in the course are design methods and applications in the contemporary urban context of Europe and North America.

**LA 483 Design Criticism**

Fall. 3 credits.

A practicum in writing environmental design criticism. Emphasis on impressionistic writing, on analytical descriptions and interpretations or works, and on the role of criticism in environmental design discourse.

**LA 486 Community Design Workshop**

Spring. 3 credits. Permission of instructor. S-U grades optional.

This class will offer the opportunity to learn, hands-on, the design process through the designing and building of service-oriented community projects including parks, greenways, public spaces, playgrounds, gardens and urban design. This course will enable students to both study and experience design and implementation skills at all levels of the design process. Community design and workshop series. Students will learn skills related to community design in a series of workshops and work on a real project with a community.

**LA 487 Experiential Community Design**

Fall. 3 credits. Permission of instructor. S-U grades optional.

This class will offer the opportunity to learn, hands-on, the design process through the designing and building of service-oriented community projects including parks, greenways, public spaces, playgrounds, gardens and urban design. This course will enable students to both study and experience design and implementation skills at all level of the design process Community Build and Implementation. Students will be engaged in the community-build phase of the community design project initiated the previous spring semester.

**LA 491 Planting Design and Establishment (also HORT 491)**

Fall. 3 credits. Prerequisites: FOH 230 or permission of instructor.

This course will focus on the establishment of woody and herbaceous plants in urban and garden settings. By understanding the special constraints placed on plants, we will be able to critically assess and modify potential planting sites, select appropriate trees, shrubs, and ground covers for a given site, and learn about the principles and practices of plant establishment both in the ground and in contained environments. Design followed by

specifications and graphic details will be produced to implement these practices. Techniques for tree preservation and land reclamation/vegetation will also be discussed. Field work includes chemical and physical analysis of soils, vegetation, and site assessment.

#### **LA 494 Special Topics in Landscape Architecture**

Fall or spring. 1-3 credits; may be repeated for credit. S-U grades optional. Topical subjects in landscape architectural design, theory, history, or technology. Group study of topics not considered in other courses.

#### **LA 497 Individual Study in Landscape Architecture**

Fall or spring. 1-5 credits; may be repeated for credit. Students must register with an Independent Study form (available in 140 Roberts Hall). S-U grades optional. Work on special topics by individuals or small groups.

#### **LA 498 Undergraduate Teaching**

Fall or spring. 1-3 credits. Prerequisites: previous enrollment in course to be taught and permission of instructor. Students must register with an Independent Study form (available in 140 Roberts Hall). S-U grade optional.

Designed to give qualified undergraduates experience through actual involvement in planning and teaching courses under the supervision of department faculty.

#### **LA 501 Composition and Theory**

Fall. 6 credits. Limited to graduate students. Cost of drafting supplies about \$200. Field trip about \$250. Basic design principles and processes applied to the design of the outdoor environment. Studio projects focus on the analysis, organization, and form of outdoor space through the use of three-dimensional components including structures, vegetation, and earthform.

#### **LA 502 Composition and Theory**

Spring. 6 credits. Limited to graduate students. Cost of drafting supplies, about \$200; expenses for field trip, about \$250. The studio will focus on the spatial design of project-scale site development. Students will develop their expertise in applying the design theory, vocabulary, and graphic expression introduced in LA 501.

#### **LA 505 Graphic Communication I**

Fall. 3 credits. Prerequisites: concurrent enrollment in LA 501 or permission of instructor.

Basic skills in graphic presentation, including pencil-and-ink drawing and drafting techniques applicable to landscape architecture projects. Basic design in freehand drawing, orthographic projection, axonometric projection, and lettering are covered in the course.

#### **LA 506 Graphic Communication II**

Spring. 3 credits. Prerequisites: LA 505 and concurrent enrollment in LA 502 or permission of instructor. Course will focus on modes of landscape representation from ideation to presentation. Projects will in many cases correspond with LA 502 design projects. Representation modes will include for example: freehand, analysis and orthographic drawing; concept modelling; composite drawings; visual books.

#### **LANAR 520 Contemporary Issues in Landscape Architecture\***

Fall. 2 credits. \*Offered through the College of Architecture, Art, and Planning.

#### **LANAR 524 History of European Landscape Architecture\***

Spring. 3 credits. \*Offered through the College of Architecture, Art, and Planning.

#### **LANAR 525 History of American Landscape Architecture\***

Fall. 3 credits. \*Offered through the College of Architecture, Art, and Planning.

#### **LA 569 Archaeology on Preservation Planning and Landscape (also CRP 569)**

Fall. 3 credits. Offered alternate years. Next offered 1998-99. In response to federal, state, and local legislation, archaeology now plays an important role in design, planning, and land-use decisions. Students develop the research skills needed to complete environmental review projects and historic landscape plans.

#### **LA 590 Theory Seminar**

Fall. 3 credits. For graduate students in their last year of study. Seminar in research methods and landscape knowledge, culminating in a thesis proposal.

#### **LA 601 Context and Landscape/Integration of Reality**

Fall. 6 credits. Limited to graduate students. Cost of supplies, about \$200; expenses for field trip, about \$250. Design theory and process as applied to larger scale, site-specific projects while incorporating skills and techniques from site engineering.

#### **LA 602 Natural Systems and Planting Design Studio**

Spring. 6 credits. Limited to graduate students. Cost of drafting supplies, about \$200; expenses for field trip, about \$250. The studio focuses upon site-scaled projects that have as a primary concern natural systems and the ecology of a site. Projects will have nature-like design expressions inherent in the studio exercises. Design knowledge of hydrology, soils, plant associates, culture, geography, history and microclimate are necessary to engage studio projects. Studio participants are expected to have a mastery of communication skills including oral presentation and graphic representation.

#### **LA 615 Site Engineering I**

Spring. (1st seven weeks of semester). 2 credits. Prerequisite: permission of instructor. Lectures and studio projects focusing on the development of a working knowledge of site grading, earthwork, storm-water management, site irrigation, site layout, and road alignment.

#### **LA 616 Site Engineering II**

Fall. (2nd seven weeks of semester). 2 credits. Prerequisite: LA 615. Lectures and studio projects dealing with earthwork estimating, storm water management, site surveys, site layout, site irrigation and horizontal and vertical road alignment.

#### **LA 617 Site Construction I**

Fall (1st seven weeks of semester). 2 credits. Prerequisite: permission of instructor.

The detail design and use of landscape materials, used by landscape architects in project implementation is the focus of this course. The course format includes lectures, field trips, studio problems, and development of technical drawings leading to construction documentation for a wide variety of projects. Students will construct detail material prototypes and models and have the option of developing computer-generated drawings.

#### **LA 618 Site Construction II**

Spring. (2nd seven weeks of semester). 2 credits. Prerequisite: permission of instructor.

Exploration of materials, including specifications, cost estimates, and methods used by landscape architects in project implementation is the focus for this course. The course includes lectures, short studio problems, and the development of drawings leading to construction documentation for a comprehensive project. Students will develop a site survey and measured drawings as necessary to develop the comprehensive project.

#### **LA 619 Advanced Site Grading**

Spring (2nd seven weeks of semester). 2 credits. Limited to 10 students. Prerequisite: LA 315 or LA 615. Grading skills and knowledge applied as a design component of site planning projects.

#### **[LA 666 Pre-Industrial Cities and Towns of North America (also CRP 666)]**

Fall. 3 credits. Offered alternate years. Not offered 1996-97; next offered 1997-98. Various American Indian civilizations as well as diverse European cultures have all exerted their influences on the organization of town and city living. Each culture has altered the landscape in their own unique way as they created their own built environments.]

#### **LA 680 Graduate Seminar in Landscape Architecture**

Fall or spring. 1-3 credits. May be repeated for credit. Limited to graduate students. S-U grades optional. Topical subjects in landscape architectural design, theory, history, or technology. Seminar topics and group study not considered in other courses.

#### **LA 694 Special Topics in Landscape Architecture**

Fall or spring. 1-3 credits; may be repeated for credit. S-U grades optional. Topical subjects in landscape architectural design, theory, history, or technology. Group study of topics not considered in other courses.

#### **LA 701 Urban Design and Planning (also CRP 555)**

Fall. 6 credits. Limited to graduate students. Cost of supplies, about \$200; expenses for field trip, about \$250. Application of urban-design and town-planning techniques to specific contemporary problems of city environments. Issues of urbanism are investigated and applied to physical design interventions and spatial typologies involving the street, square, block, garden, and park systems. 3-d computer modeling and digital design media are introduced as tools for urban design. This is a specially arranged collaborative studio with the Department of City and Regional Planning.



**LA 702 Advanced Design Studio**

Spring. 6 credits.

This advanced studio provides the opportunity to deeply explore issues of contemporary landscape architecture and integrate the related fields of ecology and sociology. Topics examined include the influences of culture, ethics, and criticism, as well as the roles and reinterpretations of engineering and representation.

**LA 800 Master's Thesis in Landscape Architecture**

Fall or spring. 9 credits.

Independent research, under faculty guidance leading to the development of a comprehensive and defensible design or study related to the field of landscape architecture. Work is expected to be completed in final semester of residency.

**NATURAL RESOURCES**

D. J. Decker, chair; R. A. Baer, M. B. Bain, B. L. Bedford, T. Brown, L. E. Buck, P. Curtis, T. J. Fahey, T. A. Gavin, J. W. Gillett, J. Jacobson, B. A. Knuth, M. E. Krasny, C. C. Krueger, J. P. Lassoie, R. A. Malecki, B. Matthews, R. J. McNeil, E. Mills, A. N. Moen, M. E. Richmond, L. Rudstam, J. Schelhas, R. Schneider, C. R. Smith, L. H. Weinstein, B. T. Wilkins, J. B. Yavitt

**Note: class meeting times are accurate at the time of publication. If changes are necessary, the department will provide new information as soon as possible.**

**NTRES 100 Principles of Conservation**

Fall. 3 credits. Limited to students specializing in natural resources or with permission of instructor. Letter grade only. M W F 9:05; 1 hr disc to be arranged. Staff.

The nature of natural resources, how they are managed, and their interactions with individuals and societies are considered. Case histories are used to illustrate both principles and practices. Emphasis will be on management of renewable resources based on ecological and cultural perspectives.

**NTRES 101 The Environment**

Fall. 2 or 3 credits. Letter grade only. M 7:30-9:30 p.m. Optional 1 hr disc sec to be arranged. B. L. Bedford.

An overview of Earth's environmental problems. Lectures are presented by a series of Cornell's most distinguished authorities and by visiting experts. A major theme of the course is that environmental problems, and their solutions, are not isolated technical problems, but rather are interrelated social, political, ethical, ecological and economic problems.

**NTRES 104 Natural History Information Management Concepts**

Spring. 1 credit. Letter grade only. T 9:05. A. N. Moen.

Natural history information management concepts using electronic technology to provide global access to information resources will be introduced. Students will learn how to access and prepare hypertext and multimedia files of natural history information.

**NTRES 105 Natural History Information Management Applications**

Fall and spring. Credit to be arranged. Letter grade only. 3 hours (TBA) per credit hour. Prerequisite: NTRES 104 (or concurrent registration). A. N. Moen.

Natural history information will be used to learn computer-based information management skills and to produce information resources for use in other courses in the Department of Natural Resources. Sections will include: (1) Natural History of Plants; (2) Natural History of Animals; and (3) Decision Aids for Laboratory and Field Identification.

**NTRES 201 Environmental Conservation**

Spring. 3 credits. M W F 12:20; 1 hr disc sec to be arranged. T. J. Fahey.

As the end of the 20th century approaches, our lives are increasingly touched by questions about environmental degradation at local, regional, and global scales. Business as usual is being challenged. This course will stimulate you to go beyond the often simplistic portraits of the environmental dilemma offered by the mass media so that you will have a firmer basis for responsible citizenship and action on environmental issues.

**NTRES 204 Natural Resource Modeling Concepts**

Spring. 1 credit. Letter grade only. R 9:05. Prerequisite: NTRES 104 or permission of instructor. A. N. Moen.

Basic concepts underlying computer modeling in natural resources are introduced, and selected models illustrate specific biophysical, population, and simulation models.

**NTRES 205 Natural Resource Modeling Applications**

Fall and spring. Credit to be arranged. Letter grade only. 3 hours (TBA) per credit hour. Prerequisite: NTRES 204 (or concurrent registration) and one course in computer programming. A. N. Moen.

Students may enroll for variable credits in biophysical modeling, population modeling, and simulation modeling sections. Original programs are designed by the students and become part of the information resources in the Cooperative Learning Center. Sections will include: (1) Biophysical Modeling in Natural Resources; (2) Simulation Modeling in Natural Resources; and (3) Population Modeling in Natural Resources.

**NTRES 210 Introductory Field Biology**

Fall. 4 credits. Limited to 90 students. Open to sophomores and juniors with an adviser in Natural Resources or by permission of instructor. Prerequisites: BIO G 101 and 102 or equivalent. 2 overnight field trips required. Cost of field trips, approximately \$10. Lec, W 9:05; labs, M W 1:25-4:25 or T R 1:25-4:25. T. Gavin and C. Smith.

Introduction to methods of inventorying, identifying, and studying plants and animals. Students are required to learn the taxonomy, natural history, and how to identify approximately 170 species of vertebrates and 80 species of woody plants. Selected aspects of current ecological thinking are stressed. The interaction of students with biological events in the field and accurate recording of these events are emphasized.

**NTRES 215 Environmental Disruption and Regulation**

Summer, 3-week session. 3 credits. Open to high school students. Optional field trips. M W 6:15-9:30 p.m. M. Heiman.

The physical and social context of human-environmental interrelations in advanced industrial societies. Interest-group positions and the United States regulatory response on air and water pollution; toxic, nuclear, and solid waste management; and workplace hazards. The conflicts and compatibility of economic growth, social justice, and environmental quality.

**NTRES 230 Environment and Society**

Summer, 6-week session. 3 credits. T R 6:15-9:30 p.m. G. M. Berardi.

Introduction to societal and environmental factors affecting famine and starvation, "overpopulation," deforestation, water degradation and global warming. Topics include sustainable development, gene banks and biotechnology, nutritional and environmental policy, models for conservation, alternative futures. Case studies from the United States and underdeveloped countries. Optional field trips.

**NTRES 253 Applied Ecology and Ecosystem Management**

Spring. 3 credits. Prerequisites: introductory courses in biology and ecology. Lec M W 10:10-11:00; lab, T, W or F 2:30-4:00 or R 12:20-2:15. J. B. Yavitt.

The application of ecological principles to renewable resource and environmental problems. The perspective is the interactions of species within the ecosystem, which is the basic unit of study. Topics include fisheries, forests, the conservation and management of wild species, invaders and pests, and pollution. The discussion section emphasizes quantitative analysis and the use of microcomputers.

**NTRES 270 Conservation of Birds**

Spring or summer. 2 credits. C. R. Smith. A course for majors and nonmajors, focusing on bird conservation and management at the organism, population, community and landscape levels. Current resource management issues relevant to birds will be explored in the contexts of agricultural practices, habitat management, tropical deforestation, the design and management of natural preserves, endangered species management, global climate change and the economic importance of bird study as an outdoor recreational activity.

**NTRES 271 Conservation of Birds Laboratory**

Spring or summer. 1 credit. Concurrent enrollment in NTRES 270 required. Limited to NTRES majors.

A field-oriented course designed to teach skills of bird observation and identification based on the integration of field marks, songs and calls, and habitat cues. Topics covered will include the choice and effective use of field guides, binoculars, and other aids to bird identification; procedures for taking and organizing field notes; the relationships of birds to their habitats and to other birds; and methods and procedures for censusing and surveying songbird populations. Students are required to provide their own binoculars for field use.

**NTRES 300 International Environmental Issues**

Fall. 3 credits. Junior standing or above.  
T R 9:05-9:55; 1 hr disc sec to be arranged.  
R. J. McNeil.

Lectures will survey international environmental issues, with some attention to causes and to solutions. Case studies will include such subjects as whales and whaling, tropical deforestation, endangered species and biodiversity, Law of the Sea, Antarctica, ozone depletion, global warming. Institutions such as treaties, development banks, international law, and trade agreements will be examined. Perspectives will include primarily ecology, secondarily ethics, economics, law.

**NTRES 301 Forest Ecology**

Fall. 3 credits. Prerequisite: Introductory Biology. M W F 11:15. T. J. Fahey.

A comprehensive analysis of the distribution, structure, and dynamics of forest ecosystems. Topics include paleoecology of forests, ecophysiology of forest trees, disturbance, succession and community analysis, primary productivity, and nutrient cycling.

**NTRES 302 Forest Ecology Laboratory**

Fall. 1 credit. Cost of weekend trip approximately \$30. Concurrent enrollment in NTRES 301 required. M 1:25-4:25.  
T. J. Fahey.

Field trips designed to familiarize students with the nature of regional forests and to provide experience with approaches to quantifying forest composition and its relation to environmental factors. Optional weekend field trips to Adirondacks and White Mountains, New Hampshire. Group research projects in local forests.

**NTRES 303 Forest and Woodlot Management**

Fall. 3 credits. Letter grades only. Lec,  
T R 10:10-11:00; lab R 12:20-4:25.  
T. J. Fahey.

A practical, field-oriented course emphasizing multiple purpose management of small nonindustrial private forestland in the northeastern United States.

**NTRES 304 Wildlife Ecology Concepts**

Spring. 1 credit. Letter grade only.  
M W F 11:15. (1st 1/3 of the semester).  
A. N. Moen.

The main concepts underlying wildlife behavior, physiology, nutrition, and energetics are discussed in an ecological context as a basis for further study in the NTRES 305 sections associated with this course.

**NTRES 305 Wildlife Ecology Applications**

Fall and spring. Credit to be arranged.  
Letter grade only. 3 hours (TBA) per credit hour. Prerequisites: NTRES 304 (or concurrent registration).

Field research and computer simulations provide in-depth study in wildlife behavior, physiology, nutrition, and energetics sections in cooperative learning environment. All students publish their findings on the information system in the Cooperative Learning Center. Sections will include: (1) Wildlife Behavior; (2) Wildlife Physiology; (3) Wildlife Nutrition; and (4) Wildlife Energetics.

**NTRES 306 Coastal and Oceanic Law and Policy**

Summer. 2 credits. A special 1-week course offered at Cornell's Shoals Marine Laboratory (SML), on an island off Portsmouth, N.H. For more details and an application, consult the SML office, G14 Stimson Hall. Estimated cost (includes tuition, room and board, and ferry transportation), \$950.

Intended for persons interested in careers in management of marine or coastal resources or in the natural sciences. Subjects include law and policy related to ocean dumping, marine sanctuaries, environmental impact statements, water and air pollution, fisheries management, offshore gas and oil production, and territorial jurisdiction. Lectures on the status and history of law are accompanied by discussion of relevant policy and efficacy of various legal techniques. A case study that requires extensive use of the laboratory's library and personnel is assigned. The week concludes with a mock hearing.

**NTRES 308 Natural Resources Management**

Fall. 3 credits. Prerequisite: junior standing. M W F 10:10. B. A. Knuth.

Focus is on fish, wildlife, forest, and water resources. Concepts emphasized include the comprehensive planning process and human dimensions of resource management. Students integrate organismal, environmental, social and institutional dimensions of management through case studies. Grades are based on individual and group performance.

**NTRES 309 Land and Culture: Systems of Native American Resource Management**

Summer. 3 credits. Prerequisite: none required; one course each in Natural Resources and American Indian Program recommended. S. M. Penningroth.

This course presents a cross-cultural examination of natural resource management on land inhabited by indigenous peoples, with an emphasis on the United States. Topics include Native religions, technologies, and science; the political and legal basis of tribal sovereignty; and "cultural economics", defined as the tension between traditional Native uses of natural resources and tribal economic development.

**NTRES 350 Ecological Dimensions of Global Change**

Fall. 3 credits. Prerequisites: college-level courses in biology and chemistry.  
T R 2:30-3:20, disc sec, T or R 3:35-4:25.  
J. B. Yavitt.

A course for students in any major examining how human-induced changes in the biosphere (e.g., land-use change) force climatic change. Lectures present a comprehensive understanding of our climatic system. Discussions consider the response of biosphere to different scenarios of climatic change and some of the policy intended to mitigate the effects of changes.

**[NTRES 400 International Environmental Issues**

Fall. 4 credits. Limited to about 35 students. Prerequisite: junior standing or above. Not offered fall 1996.

International aspects of the preservation and development of environmental and natural resources. Concepts include development, resource ownership, exploitation, compensation, and preservation. Cultural differences in

attitudes and behavior toward environment. Management practices under different cultural, economic, and social systems. Will cover current issues such as acid precipitation; management of migratory whales, fish, and waterfowl; Antarctic development; global climate and energy issues; and preservation of tropical rainforests and endangered species. Lecture and discussion, term paper, and examinations. Priority to: seniors, a few graduate students, others providing best mix of backgrounds, others with special needs, natural resources majors.]

**NTRES 401 Environmental and Natural Resources Policies**

Fall or spring. 3 or 4 credits. Prerequisites: junior standing and participation in Cornell-in-Washington Program.

Concepts and principles fundamental to the environmental policy process and central to decision making in the natural resources arena, particularly at the national and international levels. Role of the legal system in the policy process; roles of citizen organizations, lobbyists, bureaucrats, legislators. Case studies, interviews with Washington officials, several short papers, one exam. A fourth credit available requires a more extensive written assignment and an oral presentation.

**NTRES 402 Natural Resources Policy, Planning, and Politics**

Spring. 3 credits. Prerequisites: junior standing and permission of instructor. Lec, January two-week intersession; two 2 hr orientation sessions in December and four 2 hr sessions in January and February.

An introduction to the environmental policy process and its conceptual framework. Recognition of phenomena identified as natural resources or environmental problems and issues; steps leading to legislation or regulations to solve problems; implementation and evaluation stages; role of the legal system; roles of citizens, lobbyists, government actors. Case studies; presentations by and discussions with about twenty prominent Washington policy makers appearing as guest lecturers. Required interviews, term paper, oral reports. Several meetings in Ithaca before and after intensive January session in Washington.

**NTRES 404 Wildlife Populations Ecology**

Spring. 1 credit. Letter grade only.  
Prerequisites: NTRES 204 or permission of instructor. M W F 11:15. (second 1/3 of the semester). A. N. Moen.

The main concepts underlying population dynamics of free-ranging species are discussed in an ecological context as a basis for further study in the NTRES 405 sections associated with this course. The emphasis is on analytical population models rather than descriptive population parameters.

**NTRES 405 Wildlife Population Applications**

Fall and spring. Credit to be arranged.  
Letter grade only. 3 hours (TBA) per credit hour. Prerequisites: NTRES 404 (or concurrent registration).

Population estimating techniques, simulation models, and reconstruction models provide in-depth experience in these population application sections. Students may reregister for the sections in order to continue model development. Sections will include (1) Wildlife Population Estimating Techniques; (2) Wildlife Population Simulation Models; and (3) Wildlife Population Reconstruction Models.

**NTRES 406 Ecology Risk Assessment**

Spring. 3 credits. Prerequisites: BIOES 261 or equivalent; permission of instructor if not an advanced student in natural sciences of engineering. Offered alternate odd years. Next offered spring 1997 and spring 1999. M W F 11:15-12:05. J. W. Gillett.

This course strives to develop understanding of and competence in the different types of ecological (non human health) risk assessments. Focus is on cases for chemical, physical, and biological stressors in a variety of circumstances. The proposed USEPA approach under development will serve as the working model.

**NTRES 407 Religion, Ethics, and the Environment**

Spring. 4 credits. For juniors, seniors, and graduate students; others by permission only. S-U grades optional. T R 9:05-9:55; a hr disc to be arranged. R. A. Baer.

A study of how religion (mainly Christianity and Judaism), philosophy, and ethics contribute to our understanding and treatment of nature. Terms like religion, value, knowledge, nature, and the public interest are examined in detail. Particular themes include the structure of modern science, the nature of moral claims, character and moral development, and the role of mediating structures in fostering environmentally responsible behavior. Also, animal rights; responsibility to future generations; anthropocentric, biocentric, and theocentric views of human beings and nature.

**NTRES 408 Resource Management and Environmental Law**

Fall. 3 credits. For juniors, seniors, and graduate students. S-U grades optional. T R 10:10-12:05. Staff.

A senior-level course that introduces the use of legal concepts, doctrines, and remedies in natural resource and environmental management. For a variety of living resources and their habitats, it explores the common law and regulatory processes available for resolving conflicts between exploitation and protection and stresses a practical understanding of how public and private values, economic considerations, and constitutional limitations affect management techniques and objectives.

**NTRES 410 Wildlife Management Concepts and Applications**

Spring. 3 credits. Prerequisites: broad background in biology, NTRES 304 (Wildlife Species Ecology) or NTRES 404 (Wildlife Populations Ecology). This course is open to seniors and graduate students. M W F 9:05. A. Moen.

In-depth analyses of the ecological basis for decision making in wildlife management, computer simulations of management problems and effects of options, management information systems, and preparation of computer-based landscape files. Local field trips are taken.

**NTRES 411 Seminar in Environmental Ethics**

Fall. 3 credits. For graduate students, seniors, and juniors. S-U grades optional. W 1:25-3:50.

Moral concerns relative to agriculture and/or the environment. In successive years, the seminar will focus on such topics as (1) animal rights and animal welfare, (2) natural resources management and the concept of the public interest, (3) doing

environmental ethics in a democratic and pluralistic society, and, (4) land use ethics.

**NTRES 415 Principles and Practices of Agroforestry (also Hort 415)**

Spring. 2 credits. Prerequisites: senior or graduate standing or permission of instructor. S-U option. Lec, W 10:10-11:00; lab, W 1:25-4:30. J. Lassoie and K. Mudge.

An introduction to modern and traditional agroforestry systems involving the spatial or temporal integration of multipurpose woody plants (trees and/or shrubs) with annual or perennial crops and/or with livestock. Interactions between woody and non-woody components of agroforestry systems will be considered from the standpoint of above and below ground resource capture. The sustainability of agroforestry systems will be critically examined from both a biophysical and socioeconomic perspective. Laboratory sessions will include field trips, case studies, use of computer-based sources of information, and practical skills involved in woody plant management (identification, propagation, planting, pruning, measurement.)

**NTRES 417 Wetland Resources**

Summer. 2 credits. Prerequisite: one year of college biology. A special 1-week course offered at Cornell's Shoals Marine Laboratory (SML), on an island off Portsmouth, N.H. For more details and an application, consult the SML office, G14 Stimson Hall. Estimated cost (includes tuition, room and board, and ferry transportation), \$950.

An examination of coastal and adjacent freshwater wetlands from historic, destruction, and preservation perspectives, including fresh- and salt-marsh ecology and management. Field trips to selected examples of the wetlands under discussion and follow-up laboratories emphasize successional features, plant identification and classification, and examination of the dominant insect and vertebrate associations.

**NTRES 418 Wetland Ecology and Management-Lecture**

Fall. 3 credits. (Students may not receive credit for NTRES 418 and NTRES 417 Wetland Resources, Shoals Marine Laboratory summer course.) T R 12:20-1:35. B. L. Bedford.

Examination of the structure, function, and dynamics of wetland ecosystems with an emphasis on principles required to understand how human activities affect wetlands. Current regulations, protection programs, and management strategies are considered.

**NTRES 419 Wetland Ecology and Management-Laboratory**

Fall. 1 credit. Optional. Concurrent enrollment in NTRES 418 is required. W or F 12:20-4:25. One weekend fieldtrip required.

An integrated set of laboratory field exercises designed to expose students to: (a) the diversity of wetland ecosystems; (b) the flora, fauna, soils, and hydrology of wetlands within the region; (c) methods of sampling wetlands vegetation, soils, and water; and (d) methods of wetland identification and delineation. Some exercises will require written reports.

**NTRES 438 Fishery Management**

Spring. 3 credits. Offered alternate odd years. Next offered spring 1997. Lec, T R 10:10; disc, T or R 11:15. C. C. Krueger.

Introduction to management as an adaptive process that focuses on achievement of goals. Coverage includes sport and commercial fisheries and species restoration. Topics include setting goals and objectives, regulations, habitat management, population control, stocking, and management of trout, reservoirs, the Great Lakes, and Pacific halibut. Ecological, social, political, and economic aspects of those topics are discussed.

**[NTRES 442 Techniques in Fishery Science]**

Fall. 5 credits. Limited to 15 upperclass and graduate fishery students. Cost of field trips, no more than \$30. Offered alternate odd years. Next offered fall 1997 and fall 1999. T R 1:25-4:25; 1 or more weekend field trips. C. C. Krueger.

Emphasis is on methods for collecting data from fish populations and their habitat. Topics include passive and active fish-capture methods, tagging and marking, and physical and chemical habitat measurements. Assumptions and limitations inherent in data sets, research planning, and scientific report writing are also discussed. Several field trips provide hands-on experience in data collection on streams and lakes.)

**NTRES 450 Conservation Biology**

Fall. 3 credits. Prerequisite: a reasonable biology background. Lec, T 10:10-12:05; disc, R 10:10 or 11:15. T. A. Gavin.

Biological topics important to the maintenance of biological diversity will be emphasized. Examples include population viability analysis, and the analysis of the demography and genetics of small populations as they are affected by habitat fragmentation and isolation. Students will gain thorough familiarity with these concepts and their potential application through lectures, discussion, and use of computer models.

**NTRES 471 Management of Terrestrial Habitats**

Spring or summer. 2 credits. Prerequisites: NTRES 210, 304; statistics recommended; junior standing or above. Lec/lab, W 1:25-4:25. C. R. Smith.

A landscape ecological approach will be used to introduce students to habitat concepts and to methods of inventorying, measuring, monitoring, describing, classifying, and restoring terrestrial habitats at a variety of temporal and spatial scales. Field trips will be taken to areas managed by both public and private land management organizations. An introduction to use of Global Positioning Systems (GPS) is included.

**NTRES 493 Individual Study in Resource Policy, Management, and Human Dimensions**

Fall or spring. Credit to be arranged. S-U grades optional. Prerequisite: permission of instructor. R. A. Baer, T. Brown, L. E. Buck, D. J. Decker, J. Gillett, B. Knuth, B. Matthews, R. McNeil.

Topics in environmental and natural resource policy, management, and human dimensions are arranged depending on the interests of students and availability of staff. Students must register with an Independent Study form (available in 140 Roberts Hall).

**NTRES 494 Special Topics in Natural Resources**

Fall or spring. 4 credits maximum. S-U grades optional.

The department teaches "trial" courses under this number. Offerings vary by semester, and

will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

**NTRES 495 Individual Study in Fish and Wildlife Biology and Management**

Fall or spring. Credit to be arranged. S-U grades optional. Prerequisite: permission of instructor. M. Bain, T. Gavin, C. Krueger, R. Malecki, E. Mills, A. Moen, M. Richmond, L. Rudstam, C. Smith.

Topics in fish and wildlife biology and management are arranged depending on the interests of students and availability of staff. Students must register with an Independent Study form (available in 140 Roberts Hall).

**NTRES 496 Individual Study in Ecology and Management of Landscapes**

Fall or spring. Credit to be arranged. S-U grades optional. Prerequisite: permission of instructor. B. Bedford, T. Fahey, M. Krasny, J. Lassoie, J. Schelhas, R. Schneider, J. Yavitt.

Topics in ecology and management of landscapes are arranged depending on the interests of students and availability of staff. Students must register with an Independent Study form (available in 140 Roberts Hall).

**NTRES 498 Teaching in Natural Resources**

Fall and spring. 1-4 credits. Prerequisite: permission of instructor. Students must register with an Independent Study form (available in 140 Roberts Hall). S-U grades optional.

Course designed to give students an opportunity to obtain teaching experience by assisting in labs, field trips for designated sections, discussions, and grading. Students will gain insights into the organization, preparation, and execution of course plans through application and discussions with instructor.

**NTRES 500 Professional Projects—M.P.S.**

Fall and spring. Credit to be arranged. Limited to graduate students working on professional master's projects. S-U grades only.

**NTRES 601 Seminar on Selected Topics in Fishery Biology**

Fall or spring. 1 credit. S-U grades only. R 3:30-5:00.

**NTRES 604 Seminar on Selected Topics in Resource Policy and Management**

Fall. 2 credits. S-U grades optional. M 3:00-4:30.

Primarily for graduate students with a major or minor in resource policy and management and upper level undergraduates with a strong interest in resource policy analysis. Topics include the policy process, actors and stakeholders, ethical dimensions, and evaluation. Emphasis is placed on discussion, faculty-student interaction, communication skills, and current resource policy issues.

**[NTRES 607 Ecotoxicology (Toxicology 607)]**

Spring. 3 credits. Prerequisites: graduate or senior status and two 300-level courses in chemistry, biological science, or toxicology. Offered alternate even years. Not offered spring 1997. M W F 11:15.

Lectures, readings, and special guests focus on the principles of effects of toxic chemicals on natural ecosystems, their components, and

processes. Major topics include fate and transport of chemicals (chemodynamics), comparative biochemical toxicology, ecosystem process analysis, simulation through mathematical and physical (microcosm) models, and relationships to regulation and environmental management.]

**NTRES 610 Introduction to Chemical and Environmental Toxicology**

Fall. 3 credits. Prerequisites: biochemistry and animal physiology. Letter grade only. M W F 11:15-12:05.

Introduction to the basic concepts of toxicology, exposure and biological responses to toxicants, methods of assessing toxicity, and the role of epidemiology. The chemical and biological factors that affect toxicity and specific sources of toxicants, including air pollution, agriculture, industrial and commercial processes, natural occurring toxicants, and social poisons will be presented. Regulation of toxic materials will be introduced.

**NTRES 612 Wildlife Science Seminar**

Fall and spring. 1 credit. Prerequisite: permission of instructor. S-U grades optional.

Discussion of individual research or current problems in wildlife science.

**NTRES 615 Case Studies and Special Topics in Agroforestry**

Fall. 2 credits. Prerequisites: NTRES/HORT 415 or permission of instructor. S-U only. Hours to be arranged.

Interdisciplinary groups of students examine case study examples of agroforestry practices in developed and developing countries. Specific topical areas are examined in depth, leading to development of a team-written report and a class presentation. Extensive library research and participation in small group discussions are required.

**NTRES 616 Forest Science and Management Seminar**

Fall/spring. 1 credit. Permission of instructor.

Selected readings and discussions of research and/or current problems in forest science and management.

**NTRES 618 Critical Issues in Conservation and Sustainable Development**

Fall. 3 credits. Preference to graduate students with minor in conservation and sustainable development; seniors by permission. Limited to 30 students. T R 2:30-4:25. J. Schelhas.

Establishes a theoretical foundation for analyzing and addressing conservation and development issues from an interdisciplinary perspective. Engages students in the inherent conflicts between natural resource conservation and the development for human needs. Students will work in interdisciplinary groups to analyze issues and cases from both developing and developed countries.

**NTRES 619 Field Practicum in Conservation and Sustainable Development**

Spring. 3 credits. Prerequisites: NTRES 618; preference given to graduate students with minor in conservation and sustainable development; permission of instructor. Limited to 12 students. Includes two-week field study trip to a Latin American country in January. J. Schelhas.

An interdisciplinary study of a conservation and development problem in Costa Rica or the Dominican Republic. The course will use an interdisciplinary research methodology that includes group problem identification, individual or small group research projects, and synthesis of group work to identify key conservation issues and research priorities for a selected site.

**NTRES 694 Special Topics in Natural Resources**

Fall or spring. 4 credits maximum. S-U grades optional.

The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

**NTRES 698 Current Topics: Environmental Toxicology (Toxicology 698)**

Fall, spring. 1-3 credits. Prerequisites: graduate or senior standing in scientific discipline and permission of instructor.

A student-faculty colloquium on subjects of current interest, usually focusing on multidisciplinary aspects of topical problems (e.g., Superfund, oil spills).

**NTRES 699 Graduate Individual Study in Natural Resources**

Fall or spring. Credit to be arranged. S-U grades optional. Prerequisite: permission of instructor. NTRES Graduate Faculty.

Study of topics in natural resources more advanced than, or different from, other courses. Subject matter depends on interests of students and availability of staff.

**NTRES 800 Master's Thesis Research**

Fall and spring. Credit to be arranged. Limited to graduate students working on master's thesis research. S-U grades only.

**NTRES 900 Graduate-Level Thesis Research**

Fall and spring. Credit to be arranged. Limited to graduate students in a Ph.D. program **only before** the 'A' exam has been passed. S-U grades only.

**NTRES 901 Doctoral-Level Thesis Research**

Fall and spring. Credit to be arranged. For students admitted to candidacy after the 'A' exam has been passed. S-U grades only.

**Related Courses in Other Departments**

See department advisers and curriculum materials for information about other related courses.

Environment and Society (R SOC 324, 440, 495)

Ecology and Biology (ENTOM 456, 470, 471; BIOES 263, 272, 278, 452, 457, 461, 462, 471, 472, 475, 476, 478)

Environmental Law, Ethics, and Philosophy (S&T 206; CRP 451; PHIL 241, 246, 247, 381)

Human Systems and Communication (COMM 352, 360, 421)

Physical Sciences (ABEN 435, 475; SCAS 260, 371, 483; GEOL 103, 104; CEE 432)

Public Policy and Politics (GOVT 427, 428; BIO & SOC 461; CEE 529)



Resource Economics (ARME 100, 250, 450; ECON 309)

Spatial Data Interpretation (SCAS 420, 461, 620, 660)

## PLANT BREEDING

E. D. Earle, chair; W. R. Coffman, M. M. Kyle, S. R. McCouch, M. A. Mutschler, W. D. Pardee, K. V. Raman, M. E. Smith, M. E. Sorrells, J. C. Steffens, S. D. Tanksley, D. R. Viands, R. W. Zobel

Emeritus Professors: R. E. Anderson, H. L. Everett, C. C. Lowe, H. M. Munger, R. P. Murphy, R. L. Plaisted and D. H. Wallace

Biometry courses are listed under "Biometry and Statistics."

**Note:** class meeting times are accurate at the time of publication. If changes are necessary, the department will provide new information as soon as possible.

### PL BR 201 Plants, Genes, and Global Food Production

Spring. 2 credits. Prerequisite: one year of introductory biology or permission of instructor. Lecs, T R 11:15.

S. R. McCouch.

This course provides an introduction to Plant Breeding. It offers a sense of the historical and social importance of the field, tracing its evolution from the pre-scientific days of crop domestication to modern applications of biotechnology. It offers specific examples of how breeding objectives are realized and raises questions about the environmental, social and economic consequences of intensive food production systems. This course may be used for partial fulfillment of the CALS distribution requirement GROUP B - Biological Sciences.

### PL BR 225 Plant Genetics

Spring. 4 credits. Prerequisite: one year of introductory biology or permission of instructor. Limited to 50 students. Lecs, M W F 9:05; lab, T or W 1:25, lab section assignments at first lecture. Labs start first week. M. A. Mutschler.

An overview of classical and modern genetic principles using examples from a variety of ornamental, horticultural, and agronomic plant species. Labs provide hands-on experience and an independent project with *Brassica campestris*. This course may be used for partial fulfillment of the CALS distribution requirement GROUP B - Biological Sciences.

### PL BR 401 Plant Cell and Tissue Culture

Fall. 3 credits. Prerequisites: a course in plant biology, cell biology, or genetics, or permission of instructor. Lecs, T R 10:10. E. D. Earle.

Lectures and demonstrations dealing with the techniques of plant tissue, cell, protoplast, embryo, and anther culture and the applications of those techniques to biological and agricultural studies. Methods for plant improvement via manipulations of cultured cells will be discussed. Six written assignments and a term paper are required.

### PL BR 402 Plant Tissue Culture Laboratory

Fall. 1 credit. Enrollment limited. Prerequisites: PL BR 401 (may be taken concurrently) and permission of instructor. W 1:25-4:25 (alternate weeks) plus 1 hr to be arranged. E. D. Earle.

Laboratory exercises complementing Plant Breeding 401. Techniques for establishing, evaluating, and utilizing plant organ, tissue and cell cultures will be covered. Experiments will use a broad range of plant materials.

### [PL BR 446 Plant Cytogenetics Laboratory

Spring. 2 credits. S-U grades optional. Prerequisites: BIOGD 281 or PL BR 225. Lab, M 1:25-4:30. K. N. Watanabe.

This course aims to provide fundamental knowledge and techniques in plant cytogenetics. Emphasis will be on applications to research on plant genetics and plant breeding. Plant materials involve a wide range of crop species. Specific topics will be covered by invited lecturers.]

### PL BR 494 Special Topics in Plant Breeding

Fall or spring. 4 credits maximum. S-U grades optional.

The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

### PL BR 496 Internship in Plant Breeding

Fall or spring. Credits variable, may be repeated to a maximum of 6. Minimum of 60 on-the-job hours per credit granted. Prerequisites: permission of adviser and enrollment during the pre-enrollment period of the semester before the internship. Student must be a plant breeding junior or senior with a minimum 3.0 average in plant breeding courses. Students must attach to their course enrollment materials a "CALS Independent Study, Research, Teaching, or Internship" form signed by the faculty member who will supervise their study and assign their credits and grade. S-U grades only. Staff.

On-the-job learning experience under the supervision of professionals in a cooperating organization. A learning contract is written between the faculty supervisor and student, stating the conditions of the work assignment, supervision, and reporting.

### PL BR 497 Individual Study in Plant Breeding

Fall or spring. Credits variable, may be repeated to a maximum of 6. S-U optional. Prerequisite: permission of instructor. Students must register with an Independent Study form (available in 140 Roberts Hall). Staff.

### PL BR 498 Undergraduate Teaching

Fall or spring. Credits variable, may be repeated to a maximum of 6. S-U optional. Prerequisites: permission of instructor, and previous enrollment in course to be taught or equivalent. Students must register with an Independent Study form (available in 140 Roberts Hall). Staff.

Undergraduate teaching assistance in a plant breeding course. Teaching experience may include leading a discussion section, preparing and teaching laboratories, and tutoring.

### PL BR 499 Undergraduate Research

Fall or spring. Credits variable, may be repeated to a maximum of 6. S-U optional. Prerequisite: permission of instructor. Students must register with an

Independent Study form (available in 140 Roberts Hall). Staff.

Undergraduate research projects in plant breeding.

### PL BR 603 Methods of Plant Breeding

Fall. 3 credits. Prerequisites: BIOGD 281 or PL BR 225 or equivalent and an introductory course in crop production. M W F 9:05. M. E. Smith.

A comprehensive examination of plant breeding methods, including inbreeding and population improvement methods. Operational details and practical limitations for each method will be considered, as will suitability for major breeding objectives (agronomic characteristics, quality, and biotic and abiotic stress tolerance). The goal is to familiarize students with tools available to plant breeders, criteria for choosing among them, and options for creatively modifying them for specific situations.

### PL BR 604 Methods of Plant Breeding Laboratory

Fall. 2 credits. Prerequisite: PL BR 603 or equivalent (may be taken concurrently). T R 1:25-4:15. M. E. Sorrells and R. E. Anderson.

Field trips to plant breeding programs involve discussion of breeding methods used, overall goals, selection and screening techniques, and variety and germ plasm release. Additional labs include use of computers in plant breeding research and selection techniques for disease resistance. For a term project each student designs a comprehensive breeding program on a chosen crop.

### PL BR 606 Advanced Plant Genetics

Spring. 3 credits. S-U grades optional. Prerequisites: BIOGD 281, PL BR 225, or equivalent. Lecs, M W F 11:15-12:05. M. M. Kyle.

This course provides an advanced survey of genetics in higher plants. Topics include genetic analysis of developmental and metabolic processes, cytogenetics, mating behavior and barriers, and aspects of population and quantitative genetics.

### PL BR 622 Seminar

Fall or spring. 1 credit. S-U grades only. T 12:20. Staff and graduate students.

### PL BR 629 Special Topics in Plant Science Extension

Spring. 2 credits. F 1:25-4:25. W. D. Pardee.

Designed for graduate students and advanced undergraduates to provide a broader knowledge of cooperative extension philosophy and methods. Developed for students interested in extension and research in public and commercial organizations. Topics relate to extension in other countries as well as in the United States.

### PL BR 650 Special Problems in Research and Teaching

Fall or spring. 1 or more credits. Prerequisite: permission of instructor supervising the research or teaching. Staff.

### PL BR 653.1 Concepts and Techniques in Plant Molecular Biology

Fall. 1 credit. S-U grades optional. Prerequisite: BIOGD 281 and BIOBM 332 or 330 or their equivalent. Recommended: BIOBM 331. Lecs, M W F 10:10-11:00 (12 lecs). Sept. 4-Sept. 30. D. Stern and J. Steffens.

A review and update on molecular biology concepts relevant to plant sciences including DNA synthesis. RNA transcription and processing, and protein structure and translation. Methods applicable to plant molecular biology are described including isolation of nucleic acids, gel electrophoresis, recombinant DNA techniques, mutant production, DNA-protein interactions, and use of antibodies.

**PL BR 653.2 Plant Biotechnology (also Plant Pathology 663 and BIO PL 653.2)**

Fall. 1 credit. S-U grades optional. Prerequisite: BIO PL 653.1 or permission of instructor. E. D. Earle and M. Zaitlin. Lec, M W F 10:10-11:00 (12 lecs) Sept. 4-Sept. 30.

This course deals with production and use of transgenic plants for agricultural and industrial purposes. Topics include procedures for gene introduction and control of gene expression, as well as strategies for obtaining transgenic plants that are resistant to insects, diseases, and herbicides, produce useful products, or have improved nutritional and food processing characteristics. Regulatory and social issues relating to plant biotechnology are discussed.

**PL BR 653.3 Plant Genome Organization**

Fall. 1 credit. Prerequisite: BIOPL 653.1. Lec, M W F 10:10-11:00 (12 lecs) Oct. 2-Oct. 30. S. D. Tanksley.

This course will cover the origins and measurement of nuclear DNA variation in plants as well as the development and exploitation of molecular markers for breeding as well as the isolation of genes underlying interesting phenotypes.

**PL BR 694 Special Topics in Plant Breeding**

Fall or spring. 4 credits maximum. S-U grades optional.

The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

**PL BR 716 Perspectives in Plant Breeding Strategies**

Spring. 3 credits. S-U grades optional. Prerequisite: PL BR 603. Offered odd years. Next offered 1998-99. T 1:25-2:15, R 12:20-2:15. M. E. Sorrells.

Emphasis is on discussion and evaluation of selected benchmark papers and current literature. Selection techniques and breeding objectives, methods, and strategies for both self- and cross-pollinated crops are reviewed and discussed. Extensive outside reading is required.

**[PL BR 717 Quantitative Genetics in Plant Breeding]**

Spring. 3 credits. S-U grades only. Prerequisites: PL BR 603 and BTRY 601. Offered even years; next offered 1997-98. T R 8:30-9:55. D. R. Viands.

Discussion of quantitative genetics to help make decisions for more efficient plant breeding. Specific topics include components of variance (estimated from mating designs), gene pool development, linkage, heritability, phenotypic and genotypic correlation coefficients, and theoretical gain from selection. During one period, plants in the

greenhouse will be evaluated to provide data for computing quantitative genetic parameters.]

**[PL BR 718 Breeding for Pest Resistance]**

Spring. 3 credits. Prerequisites: BIOGD 281 or PL BR 225, and PL BR 603 required. An introductory course in Plant Pathology and/or Entomology also highly recommended. Lec, T R 10:10-11:30. M. A. Mutschler.

A multidisciplinary examination of the challenge of incorporating disease and insect resistance into crop plants. Topics covered include national and international germplasm collections, identification of sources of resistance, resistance mechanisms in plants, monogenic and polygenic control of resistance, approaches to breeding for resistance stability of genetic resistance mechanisms, and the use of biochemical/physiological/molecular tools in breeding for pest resistance.]

**PL BR 800 Master's-Level Thesis Research**

Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. S-U grades optional. Graduate faculty. For students working on a master's thesis.

**PL BR 900 Graduate-Level Dissertation**

Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. S-U grades optional. Graduate faculty. For students in a Ph.D. program **only before** the "A" exam has been passed.

**PL BR 901 Doctoral-Level Dissertation Research**

Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. S-U grades optional. Graduate faculty. For students admitted to candidacy **after** the "A" exam has been passed.

## PLANT PATHOLOGY

S. A. Slack, chair; J. R. Aist, P. A. Arneson, S. V. Beer, G. C. Bergstrom, B. B. Brodie, A. R. Collmer, T. P. Delaney, W. E. Fry, S. M. Gray, R. K. Horst, G. W. Hudler, R. P. Korf, J. A. Laurence, J. W. Lorbeer, R. Loria, M. T. McGrath, M. G. Milgroom, E. B. Nelson, P. F. Palukaitis, W. A. Sinclair, H. D. Thurston, B. G. Turgeon, O. C. Yoder, M. Zaitlin, T. A. Zitter

**Note: class meeting times are accurate at the time of publication. If changes are necessary, the department will provide new information as soon as possible.**

**PL PA 101 Freshman Writing Seminar: Pests, Pesticides, People, and Politics**

Fall. 3 credits. Limited to 17 students. Lec, M W F 8:00. P. A. Arneson. This seminar will examine the use of pesticides, their impact on human health and the environment, and their regulation. Beginning with Rachael Carson's classic *Silent Spring*, we will examine many facets of the pesticide controversy through readings in current popular literature, technical journals, government documents, industry propaganda, and publications of various so-called "public interest groups." We will emphasize the need for critical thinking as we explore the power of the written word to persuade.

**PL PA 102 Freshman Writing Seminar: Environmental Issues and the Changing Global Climate**

Spring. 3 credits. Limited to 17 students. Lec, T R 11:40. J. A. Laurence.

This seminar provides an opportunity to learn more about the biological, social, and political impact of environmental issues on scales ranging from local to global. Readings, discussions, and some hands-on experience will provide subjects for a seminar designed to teach writing at levels of single sentences to term papers.

**PL PA 201 Magical Mushrooms, Mischievous Molds**

Spring. 2 credits. S-U optional. Lec, T R 11:15. G. W. Hudler.

A presentation of the fungi and their roles in nature and in shaping past and present civilizations. The historical and practical significance of fungi as decayers of organic matter, as pathogens of plants and animals, as food, and as sources of mind-altering chemicals will be emphasized.

**PL PA 241 Plant Diseases and Disease Management**

Spring. 4 credits. Prerequisite: one year of biology. Lec, M W F 11:15; lab, T or W 1:25. W. E. Fry.

An introduction to plant diseases, their diagnosis, and their management. Topics covered include fungi, bacteria, viruses, nematodes, and other plant pathogens; disease cycles, plant disease epidemiology, disease forecasting, and the principles and practices of plant disease management. This course is intended for students who want a practical knowledge of plant diseases and their control. It is not an adequate prerequisite for plant pathology courses numbered 600 and above.

**PL PA 247 Nature of Sensing and Response**

Spring. 1 credit. Prerequisites: Biol. 101-104 or equivalent. Lec, R 1:25-2:15. T. P. Delaney.

The responses of organisms and cells to their surroundings are examined to illustrate how biological systems: sense their environment and communicate sensing into appropriate responses. A variety of responses will be explored to show both the unique features and similar processes that are utilized by widely divergent organisms. Examples will be portrayed of plant and animal mechanisms for light sensing, control of development and responses to disease. Discussion will also examine the role of genetics and biochemistry in understanding signal transduction pathways, as well as the way these systems are perturbed in certain diseases.

**PL PA 309 Introductory Mycology**

Fall. 3 credits. Prerequisite: a year of biology or equivalent. Concurrent registration in PL PA 319 is recommended. Lec, T R 9:05-9:55; labs, R 1:25-4:25. J. R. Aist.

An introduction to fungi, emphasizing biology, comparative morphology, and taxonomy.

**PL PA 319 Field Mycology**

Fall. 1 credit. Prerequisite: permission of instructor. R. P. Korf.

Study of mushrooms and other fungi on 7 field excursions followed by 7 evening labs devoted to identification and study of collections under the microscope. Emphasis on ecology, biology, and means of identifica-

tion. There are no lectures; grades will be determined on basis of laboratory final.

#### **PL PA 401 Basic Plant Pathology**

Fall. 4 credits. Prerequisite: one year of biology and BIO S 241 or equivalent. Recommended: general microbiology, plant physiology. Lects, T R 11:10; lab, T or W 1:25. W. A. Sinclair.

Principles and practice of plant pathology. Lectures and labs are coordinated to consider types of plant pathogens and their population dynamics, disease cycles, diagnostic criteria and procedures, mechanisms of pathogen attack and plant defense, vector relationships, epidemiology, disease forecasting, loss assessment, and disease control. This course prepares students for graduate-level work in plant pathology.

#### **[PL PA 411 Plant Disease Diagnosis**

Fall. 3 credits. For senior undergraduates specializing in plant pathology or pest management and for graduate students with a major or minor in plant pathology or plant protection. Limited to 20 students. Prerequisites: PL PA 241 or equivalent and permission of instructor. Not offered 1996-97. Lec, M 11:15; lab, M W 1:25-4:25. G. W. Hudler.

A method for diagnosis of plant disease is presented with emphasis on contemporary laboratory techniques and effective use of the literature.]

#### **PL PA 443 Pathology of Trees and Shrubs**

Fall. 3 credits. Prerequisites: PL PA 241 or equivalents. Lects, M W 11:15; labs, F 1:25-4:25. G. W. Hudler.

For students preparing for careers in horticulture, urban forestry, and pest management. Deals with the nature, diagnosis, assessment, and treatment of diseases of trees and shrubs. Forest, shade, and ornamental plants are considered.

#### **PL PA 444 Integrated Pest Management**

Fall. 4 credits. Prerequisites: BIO ES 261, ENTOM 212 or 241, or PL PA 301 or their equivalents or permission of instructor. P. A. Ameson.

Lectures integrate the principles of pest control, ecology, and economics in the management of pest-crop systems. Laboratories consist of exercises to reinforce concepts presented in lecture and demonstrate pest monitoring techniques and the application of computer technology to management problems.

#### **PL PA 494 Special Topics in Plant Pathology**

Fall or spring. 4 credits maximum. S-U grades optional.

The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

#### **PL PA 497 Independent Study**

Fall or spring. 1-5 credits. Students must register with an Independent Study form (available in 140 Roberts Hall). S-U grades optional.

An opportunity for independent study of a special topic in mycology or plant pathology under the direction of a faculty member.

#### **PL PA 498 Teaching Experience**

Fall or spring. 1-5 credits. Students must register with an Independent Study form (available in 140 Roberts Hall). S-U grades optional.

Undergraduate teaching assistance in a mycology or plant pathology course by mutual agreement with the instructor.

#### **PL PA 499 Undergraduate Research**

Fall or spring. 3-5 credits. Students must register with an Independent Study form (available in 140 Roberts Hall). S-U grades optional.

An opportunity for research experience under the direction of a faculty member.

#### **PL PA 642-661 Special Topics Series**

Unless otherwise indicated, the following description applies to courses 642-661.

Fall or spring. 1 credit. Prerequisite: permission of instructor. S-U grades only.

Weekly discussions of current topics in special areas of plant pathology and mycology. Students are required to do extensive reading of current literature and to present oral and written reports.

#### **PL PA 642 Plant Disease Epidemiology**

Spring. TBA. M. G. Milgroom.

#### **PL PA 644 Ecology of Soil-Borne Pathogens**

Fall or spring. R 12:20. E. B. Nelson.

#### **PL PA 645 Plant Virology**

Fall. F 12:20. S. M. Gray.

#### **PL PA 647 Bacterial Plant Diseases**

Fall and spring. M 9:05. S. V. Beer. Emphasizes reports of current research in phytobacteriology undertaken in laboratories at Cornell.

#### **PL PA 648 Molecular Plant Pathology**

Fall. R 12:20. T. P. Delaney.

#### **PL PA 649 Mycology Conferences**

Fall. 1 credit. R. P. Korf.

#### **PL PA 650 Diseases of Vegetable Crops**

Fall. TBA. Hours to be arranged. J. W. Lorbeer and T. A. Zitter.

#### **PL PA 652 Field Crop Pathology**

Spring. W 8:00. G. C. Bergstrom.

#### **PL PA 654 Diseases of Florist Crops**

Spring. F 12:20. R. K. Horst.

#### **PL PA 655 Plant Diseases in Tropical Agriculture**

Fall. T 12:20. H. D. Thurston.

#### **PL PA 661 Diagnostic Lab Experience**

Summer and fall. 1 or 2 credits. S-U grades only. Requires 3 hrs/wk per credit hour. Hours to be arranged. T. A. Zitter.

For graduate students and advanced undergraduates with a special interest in diagnosing plant diseases. Students will work in the Diagnostic Laboratory (Plant Pathology Department) under supervision of the diagnostician. Coursework or experience in diagnostic techniques is strongly advised. Priority will be given to graduate students in plant pathology and plant protection.

#### **PL PA 662 Molecular Plant-Pathogen Interactions**

Spring. 1 credit. Prerequisites: BIOGD 281, BIOBM 330 or 331, and BIOMI 653.1. Lects, M W F 10:10 (12 lecs) Jan. 22-Feb. 17. T. P. Delaney, A. R. Collmer, O. C. Yoder.

An examination of the molecular properties that control the development of host-parasitic interactions in both microorganisms (bacteria and fungi) and higher plants. Contemporary theories describing the genetic mechanisms of pathogenesis and resistance are discussed.

#### **PL PA 663 Plant Biotechnology (PL BR 653.2)**

Fall. 1 credit. Prerequisites: BIOGD 281, BIOBM 330 or 331, and BIOPL 653.1.

Lecs, M W F 10:10 (12 lecs) Sept. 4-Sept. 30. M. Zaitlin, E. D. Earle.

#### **PL PA 681 Plant Pathology Seminar**

Fall and spring. 1 credit. Required of all plant pathology majors. S-U grades only. W 12:20-1:10.

#### **PL PA 694 Special Topics in Plant Pathology**

Fall or spring. 4 credits maximum. S-U grades optional.

The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

#### **PL PA 701 Concepts of Plant Pathology: Organismal Aspects**

Spring. 3 credits. For graduate students with majors or minors in plant pathology; others by permission. Prerequisites: PL PA 401 or equivalent and permission of instructor. Lects, T R 9:05; lab/disc, R 2-4:25. A. R. Collmer.

Concepts in host-pathogen relationships with emphasis on roles of molecules and cells in determining the outcome of an interaction. Genetic, molecular biological, physiological, and cell biological approaches to experimental analysis of exemplary host-pathogen systems will be considered. Historical perspectives and recent research will be reviewed and analyzed. Students prepare and review mock grant proposals.

#### **PL PA 702 Concepts of Plant Pathology: Population Aspects**

Fall. 3 credits. For graduate students with a major or minor in plant pathology; others by permission. Prerequisite: PL PA 401 or permission of instructor. Some background in statistics is recommended. Lab = discussion section. Lec, T R 10:10; disc, T 2-4:25. M. G. Milgroom.

Theory and concepts in plant disease epidemiology and population biology of plant pathogens. Topics include: population dynamics of pathogens in time and space, interactions of pathogen and plant populations, and population genetics of pathogens. The discussion section will be used for examining current plant pathology literature and other exercises complementary to lecture material.

#### **PL PA 705 Phyto-virology**

Spring. 2 credits. For graduate students with a major or minor in plant pathology; others by permission. Prerequisite: PL PA 401 or equivalent. Offered alternate years. M. Zaitlin.

This course considers plant viruses and the diseases they cause. Consideration is given to virus structure and composition, classification, replication, effects on hosts, modes of transmission, and the relationships of these aspects to principles of diagnosis and control.

**[PL PA 706 Phytonematology]**

Fall. 2 credits. For graduate students with a major or minor in plant pathology; others by permission. Prerequisite: PL PA 401 or equivalent or permission of instructor. Not offered 1996-97.

Deals with morphology, anatomy, biology, physiology, ecology, detection and identification of plant pathogenic nematodes, evaluation of population data, interactions between nematodes and other plant pathogens, and methods of assessment of pathogenicity and plant damage.]

**[PL PA 707 Phytobacteriology]**

Fall. 2 credits. Prerequisites: general microbiology, lectures and laboratory; Introductory Plant Pathology. Offered alternate years. S. V. Beer.

A consideration of the prokaryotes that cause disease in plants and examples of the diseases they cause. The course emphasizes properties of bacterial pathogens that affect disease, methods for manipulation of the pathogens, and recent developments in phytobacteriology. The current state of knowledge of important phytopathogenic genera including their genetics and mechanisms of pathogenesis will be reviewed. Laboratory practice in isolation, inoculation, identification, genetics, and physiology is included.

**[PL PA 709 Phytomycology]**

Spring. 2 credits. For graduate students with a major or minor in mycology or plant pathology; others by permission. Prerequisites: PL PA 401 and 309 or equivalents, or permission of instructor. Lec, F 1:25-2:30; lab, 2:30-4:30. J. W. Lorbeer.

Provides basic information on the biology of plant pathogenic fungi with selected emphasis on the structure, ecology, genetics, life cycles, and disease cycles of representative genera and species.

**[PL PA 715 Phytovirology Laboratory]**

Spring. 2 credits. Limited to 12 students. Prerequisite: permission of instructor. S-U grades only. M. Zaitlin.

**[PL PA 735 Advanced Plant Virology]**

Spring. 3 credits. Prerequisite: permission of instructors. 3 lecs, hours to be arranged. Not offered 1996-97. P. Palukaitis and M. Zaitlin.

Topics in plant virology, with an emphasis placed on student discussion of current literature. Topics included are viral infection process, viral and viroid replication, viral recombination, viral movement, viral genes and their products, cross protection, detection of viruses, molecular approaches to resistance and the use of viruses as vectors for introducing genetic material into plants.]

**[PL PA 738 Genetics and Development of Filamentous Fungi]**

Fall. 2 credits. Prerequisite: BIOGD 281 or equivalent. Hours to be arranged. O. C. Yoder, B. G. Turgeon.

Classical and molecular approaches to the study of fungal genetics are discussed. Recently developed molecular technology is highlighted, with emphasis on transformation systems, gene disruption and replacement, gene over-expression, stability of transforming DNA, native transposons and plasmids, karyotyping by chromosome separation, and secretion of heterologous proteins. Application of contemporary methodology to genetic

dissection of developmental processes, such as plant pathogenesis (including host and tissue specificity), the mitotic and meiotic cell cycles, and conidium formation is described. Experimental evidence supporting various hypotheses to explain fungal pathogenicity is evaluated. Examples are chosen from investigations of recently developed plant pathogenic fungi such as *Cochliobolus heterostrophus* and *Magnaporthe grisea* and from well known genetic models such as *Aspergillus nidulans* and *Neurospora crassa*.

**[PL PA 739 Advanced Mycology]**

Fall. 4 credits. Prerequisites: PL PA 309 or equivalent, a course in genetics, and permission of instructor. Offered alternate years. Not offered 1996-97. R. P. Korf. A detailed study of the taxonomy, nomenclature, and biology of four major groups of fungi (rusts, smuts, peronosporales, and fungi imperfecti).]

**[PL PA 788 Research in Molecular Plant Pathology]**

Fall and spring. 2, 4, or 6 credits. Prerequisite: permission of instructor. S-U grades only. S. V. Beer. Guided research experiences in laboratories addressing questions concerning the interaction of pathogens (bacteria, fungi, viruses) and plants at the molecular level. Intended for beginning graduate students with a concentration in Molecular Plant Pathology and sufficient theoretical background and practical laboratory experience. Students submit plans and reports on each research experience.

**[PL PA 797 Special Topics]**

Fall or spring. 1-5 credits. S-U grades optional. An opportunity for independent study of a special topic.

**[PL PA 798 Graduate Teaching Experience]**

Fall or spring. 1-5 credits. S-U grades. Hours to be arranged. Staff. Graduate teaching assistance in a mycology or plant pathology course by mutual agreement with the instructor. This experience may include, but is not limited to, preparing, assisting in, and teaching laboratories, preparing and delivering lectures, leading discussion sessions, and tutoring.

**[PL PA 800 Master's-Level Thesis Research]**

Fall or spring. S-U grades optional. Credit to be arranged. Prerequisite: permission of adviser. Graduate faculty. For student's working on a master's degree.

**[PL PA 900 Graduate-Level Thesis Research]**

Fall or spring. S-U grades optional. Credit to be arranged. Prerequisite: permission of adviser. Graduate faculty. For students in a Ph.D. program who have not passed the "A" exam.

**[PL PA 901 Doctoral-Level Thesis Research]**

Fall or spring. S-U grades optional. Credit to be arranged. Prerequisite: permission of adviser. Graduate faculty. For doctoral candidates who have passed the "A" exam.

**POMOLOGY (FRUIT SCIENCE)**

See Horticultural Sciences.

**RURAL SOCIOLOGY**

D. L. Brown, chair; P. R. Eberts, E. C. Erickson, S. Feldman, J. D. Francis, C. C. Geisler, N. Glasgow, D. T. Gurak, M. M. Kritz, T. A. Hirschl, W. B. Lacy, T. A. Lyson, P. D. McMichael, M. J. Pfeffer, J. M. Stycos, R. W. Venables, L. B. Williams

**Note: class meeting times are accurate at the time of publication. If changes are necessary, the department will provide new information as soon as possible.**

**R SOC 100 American Indian Studies: An Introduction**

Fall. 3 credits. S-U grades optional. W 7:30-10:30 p.m. R. W. Venables. This course provides a foundation for the study of American Indians. Emphasis will be placed on social, cultural, historical, educational, and human development. Guest lecturers from Cornell's staff and the Indian communities and media presentations.

**R SOC 101 Introduction to Sociology**

Fall or spring. 3 credits. Lecs, T R 10:10-11:00; sec, various times. C. C. Geisler and staff.

A survey of concepts and theories in sociology and an examination of social forces and institutions shaping modern societies. The major topics include culture and socialization, social stratification and social class, age, race, ethnic and gender inequality, deviance and social control, religious, education, and occupation organizations, urbanization and demographic change, social change and social movements, bureaucracy, environmentalism, and the uses of sociology.

**R SOC 175 Issues in Contemporary American Indian Societies**

Spring. 3 credits. S-U grades optional. W 7:30-10:30 p.m. R. W. Venables. Early American Indian history and the postcontact period will be reviewed with an emphasis given to developments since 1789. Topics such as land claims, treaties, education, mineral and water rights, social problems, militant organizations, and civil rights will be covered, with guest lecturers and media presentations.

**R SOC 200 Social Problems**

Fall. 3 credits. S-U grades optional. M W F 9:05-9:55. T. A. Hirschl. This course investigates a variety of current social problems from a sociological perspective. The course begins with an overview of sociological theories that may account for social problems and identifies common as well as competing elements of these theories. The theoretical framework is then applied to analyses of a variety of social problems, and these may vary semester to semester. Examples of social problems are homelessness, teenage pregnancy, deindustrialization, and homicide, among others. Emphasis in the course will be given to how social problems are measured, and students will be given an opportunity to test theories with data analysis.



**R SOC 201 Population Dynamics**

Spring. 3 credits. S-U grades optional.  
ALS students must register for this course  
as R SOC 201. T R 8:40-9:55.  
L. B. Williams.

This course provides an introduction to population studies. The primary focus is on the relationships between demographic processes (fertility, mortality, and migration) and social and economic issues. Discussion will cover special topics related to population growth and distribution, including marriage and family formation, labor force participation, urban growth and urbanization resource allocation, and the environment.

**R SOC 205 International Development**

Spring. 3 credits. M W F 10:10-11:00.  
P. D. McMichael.

New questions concerning development models in the post-Cold War era are examined from a comparative and global perspective on North-South relations. While the focus is the "Third World," the issues confronting it are often global, even when they concern the most basic issue of food security. Using films and various theoretical perspectives, we examine Southern societies (economies, ecologies, class/gender relations) and the impact of global forces on Southern resources. Such forces include global food systems, new forms of export production, development agencies, multilateral institutions, local bureaucracies, transnational corporations, the debt crisis, and new technologies. We will also examine the new social movements, such as environmentalism, feminism, and grassroots activism.

**R SOC 206 Gender and Society (also Women's Studies 206)**

Spring. 3 credits. Lec, M W 11:15-12:05;  
sec, various times. N. Glasgow.

Course will familiarize students with origin of gender hierarchies, social and behavioral similarities/differences between females and males, and degree that biological, psychoanalytic, psychological and sociological perspectives help to understand the differences. United States and cross-cultural comparisons of the consequences of gender inequality will be a major focus of the course. Objectives will be met through lectures, readings, films, participant observation and personal experiences.

**[R SOC 208 Technology and Society**

Fall. 3 credits. Offered alternate years.  
Not offered fall 1996 and 1998; next  
offered fall 1997. M W F 10:10-11:00.  
C. C. Geisler.

The relationship between technology and society is among the most pervasive concerns of our time. Ultimately, what makes a technology useful or "appropriate" is a sociological question. Lectures and readings review classical debates regarding technology and society. Herein, students compare high technologies and appropriate technologies, identify problems associated with technology transfer to other societies, and create a list of important criteria by which technologies are judged appropriate or inappropriate using numerous case studies.]

**R SOC 213 Research Methods for the Social Sciences**

Fall. 3 credits. T R 11:40-12:55.  
L. B. Williams.

A survey of approaches to conducting research in sociology will be presented. Definitions of social indicators will be devised

and issues of data management and analysis will be demonstrated. Illustrations will be provided from data on both developed and developing countries.

**R SOC 220 Sociology of Health of Latinos and Ethnic Minorities (also Latino Studies Program 220)**

Fall. 3 credits. S-U grades optional.  
T R 10:10-11:25. P. A. Parra.

Discusses the health status of Latinos in the United States. Specifically, it will explore intragroup diversity such as migration, economic status and the influence of culture and the environment on health status and access to health care. Although focus is on Latino population, discussion encompasses other minorities who face similar problems.

**R SOC 301 Theories of Society**

Fall. 3 credits. Prerequisites: rural sociology or sociology course. S-U grades optional. M W F 11:15-12:05.  
P. R. Eberts.

An introduction to the "classical" sociological theorists for juniors, seniors, and beginning graduate students. Emphasis on (1) the central concepts of the sociological tradition, (2) major classical theorists (Marx, Durkheim, Weber) and contemporary counterparts. The relevance of these theories of society to current events and social problems will be stressed.

**[R SOC 318 Ethnohistory of the Northern Iroquois**

Fall. 3 credits. S-U grades optional. Not offered 1996-97. T 1:25-4:25.  
R. W. Venables.

The development of Iroquois (Houdenosau-nee) history and culture is traced to the present day.]

**R SOC 324 Environment and Society (also Science and Technology 324)**

Spring. 3 credits. M W F 1:25-2:15.  
M. J. Pfeffer.

The main objective of the course is to develop a critical understanding of the dominant trends in modern U.S. environmental thought like preservationism, conservationism, deep ecology, ecofeminism, social ecology, NIMBYism, risk assessment, and environmental equity. Another objective is to familiarize students with some major contemporary substantive environmental problems and policies. These topics include air and water quality, public lands management, biodiversity, deforestation, climate change, and ozone depletion. A sociological framework is applied to evaluate interrelationships between substantive and philosophical/theoretical issues.

**R SOC 331 Demographic Analysis in Business and Government**

Spring. 3 credits. S-U with permission of instructor. Prerequisite: R SOC 213 or a statistics course. M W F 1:25-2:15.  
W. Brown.

An overview of the way demographic analysis is used in business and government. Through the use of case study and problem solving methods of learning, students come to understand how demographic concepts, methods, and data are used by demographers to solve problems in business and government. The course is designed for upper-level undergraduates from a variety of academic disciplines and career orientations. Students will work on problems drawn from consumer marketing, education, housing and real estate

development, human resources, health services.

**R SOC 336 Rural Areas in Metropolitan Society**

Fall. 3 credits. S-U grades optional.  
Prerequisite: a social science course.  
Offered alternate years. T R 11:40-12:55.  
D. L. Brown.

This course analyzes the changing structure and role of small towns and rural areas in developed nations. The focus is on adaptation of rural communities and populations to major trends including increased societal differentiation and complexity; increased societal interdependence, and rapid social, economic, technological, and ecological change. Alternative policies to ameliorate rural problems and/or enhance rural contributions to national development are considered. Students participate in group projects in rural communities.

**R SOC 370 Comparative Issues in Social Stratification**

Fall. 3 credits. Prerequisite: an introductory social science course. T R 1:25-2:40.  
T. A. Lyson.

This course reviews both classical and contemporary issues in the comparative social stratification literature. Particular attention is given to the changing configurations of different labor markets, debates on the meaning of new economic constituencies, and the role of gender, race, ethnicity, and sexuality in assessing the patterns, meaning and experiences of inequality. Throughout the course we will give special attention to the importance of understanding how questions of measurement are constructed and employed in understanding social inequality.

**R SOC 380 Independent Honors Research in Social Science**

Fall and spring. 1-6 credits. Limited to students who have met the requirements for the honors program. A maximum of 6 credits may be earned in the honors program.

Students should select a faculty adviser and begin proposal development during the junior year. Students must submit written proposals by the third week of the semester of their senior year to the departmental honors committee representative, M. Pfeffer.

**R SOC 408 Human Fertility in Developing Nations**

Spring. 3 credits. Offered alternate years.  
T R 2:55-4:10. J. M. Stycos.

A review of the major literature dealing with the social causation of variation in human fertility. Emphasis will be on international comparisons and on the methodology of field research.

**[R SOC 418 Population Policy**

Spring. 3 credits. Prerequisite: R SOC 201 or permission of instructor. Offered alternate years. Not offered spring 1997 and 1999; next offered spring 1998.  
T R 10:10-11:25. J. M. Stycos.

The ways in which societies try to affect demographic trends. Special focus is on government policies and programs to reduce fertility.]

**[R SOC 425 Gender Relations, Gender Ideologies, and Social Change**

Spring. 3 credits. Offered alternate years.  
Not offered spring 1997 or 1998; next offered spring 1999. R 1:25-4:25.  
S. Feldman.

Drawing on feminist and sociological theory and methods, within a comparative and global framework, the course examines gender ideologies, work-family linkages, and the transformation of the labor process as these reconfigure gender relations, state capacities, and cultural practices.]

**[R SOC 430 Migration and Population Redistribution]**

Fall. 3 credits. Prerequisite: undergraduate, one demography course or permission of instructor. Offered alternate years. Not offered fall 1996 and 1998; next offered fall 1997. T R 8:40-9:55. D. L. Brown.

This course analyzes the determinants and consequences of internal migration in urban and rural areas of developed and developing nations. Economic and demographic interrelationships are emphasized as are implications of changes in local and regional population size and composition for labor supply, the demand for goods and services, and infrastructure. Public policy implications of the inter-relations are investigated. Techniques and measurement issues associated with the analysis of migration and population distribution are discussed.]

**R SOC 431 Social Demography of Minorities**

Spring. 3 credits. S-U option. M W 8:40-9:55. D. T. Gurak.

Ethnic conflict and accommodation is examined in diverse settings (societies and historical periods). Demographic indicators (such as residential segregation, marital patterns, mortality and fertility differentials, and occupational mobility) of underlying social conditions serve as the principal vehicle for evaluating the status of ethnic relations.

**[R SOC 437 Aging and Aging Social Policy in the 1990s]**

Fall. 3 credits. Prerequisite: R SOC 101 or its equivalent. Not offered fall 1996; next offered fall 1997. T R 11:40-12:55. N. Glasgow.

An analysis of the "graying" of America and the responses of the public and private sectors to this demographic revolution. Examines the interplay between basic and applied knowledge in social gerontology. Explores the formal and informal networks of services, in both rural and urban environments, that help maintain independent living arrangements by the elderly.]

**R SOC 438 Social Demography**

Fall. 3 credits. M W 8:40-9:55. D. T. Gurak.

This course surveys the methods, theories, and problems of population studies. Attention is directed to the social, economic, and cultural determinants and consequences of population growth, distribution, and change. The core areas of demography, fertility, mortality, and migration are studied. Comparisons are made between developed and developing areas and between Africa, Asia, and Latin America.

**[R SOC 440 The Social Impact of Resource Development]**

Spring. 3 credits. S-U grades optional. Offered alternate years. Not offered spring 1997 and 1999; next offered spring 1998. C. C. Geisler.

Social impact assessment (SIA) is a method of anticipating unwanted side-effects of projects, policies, and new technologies before they

happen and a decision tool for mitigation. The seminar explores SIA applications in different parts of the world and pays particular attention to impacts on native and indigenous peoples. Students learn practical SIA skills and related theoretical/conceptual debates.]

**[R SOC 442 American Indian Philosophies: Selected Topics]**

Spring. 3 credits. S-U grades optional. Prerequisite: Permission of instructor. Not offered 1996-97. T 1:25-4:25. R. W. Venables.

This course provides an opportunity for students to read and discuss a wide range of American Indian philosophies.]

**[R SOC 490 Society and Survival]**

Fall. 3 credits. Prerequisite: introductory sociology course or permission of instructor. Not offered 1996-97. T R 2:55-4:10. D. T. Gurak.

Course surveys existing theories, methodological techniques, and research results relating to how social, economic and cultural structures and processes affect survival chances in diverse societies. A comparative framework is presented, and the utility of existing knowledge for policy-related applications in different societies is assessed. Attention is given to the problems associated with imputing causality in morbidity and mortality data.]

**[R SOC 492 Contemporary Issues Seminars: Developments in the Pacific Rim]**

Spring. 1-2 credits. Not offered 1996-97. M 1:25-2:15. P. D. McMichael.

Pacific Rim dynamics challenge U.S. supremacy, Western conceptions of modernization, and "Third World" unity. We relate these trends to regional political, economic, and cultural forces, including the Japanese model, the "Newly Industrializing Countries" (e.g., South Korea, Taiwan), the "third tier" countries (e.g., Indonesia, the Philippines), and emerging Chinese markets.]

**R SOC 494 Special Topics in Rural Sociology**

Fall or spring. 4 credits maximum. S-U grades optional.

The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

**R SOC 495 Population, Environment, and Development in Sub-Saharan Africa**

Fall. 3 credits. Offered alternate years. M W 2:55-4:10. M. M. Kritz.

In the past three decades, countries in sub-Saharan Africa have experienced rapid population growth, weak economic growth, and growing environmental problems. This course examines how these problems are interrelated and looks at possible solutions. After reviewing trends in population, environment and development within the region, the course focuses on specific problems, including: urbanization, health and survival, population pressure and sustainable agriculture, refugees, and gender/family/community structures.

**R SOC 497 Independent Study in Rural Sociology**

Fall or spring. 3 credits variable (may be repeated for credit). Students must register with an Independent Study form (available at 140 Roberts Hall). S-U grades optional. Informal study may include a reading course, research experience, or public service experience.

**[R SOC 603 Classical Sociological Theory]**

Fall. 4 credits. Offered alternate years. Not offered fall 1996 and 1998; next offered fall 1997. S-U grades optional. Prerequisites: open to graduate students and undergraduates with permission of instructor. T R 2:55-4:10. M. J. Pfeffer.

Students will review the main streams of classical sociological thought, focusing on the work of Weber, Durkheim, and Marx. Course materials include original texts and secondary literature, used to examine the concepts, methods and explanation in classical sociological thought. Important objectives of the course will be to identify the philosophical and conceptual core of the discipline and to critically evaluate the relevance of the classical theories to contemporary social change and development.]

**[R SOC 604 Theories of Social Change]**

Spring. 3 credits. S-U grades optional. Not offered 1996-97. T R 2:55-4:10. P. D. McMichael.

This course surveys major twentieth-century social theories, focusing on lineages from classical theory and on theories relevant to understanding the processes of social change. Major topics covered will include mid-century functionalism, conflict theories, neo-Marxism, neo-Weberianism, substantive economic sociology, and world-systems theory. Other topics, such as the "new sociology of culture," critical theory, structuration theory, neofunctionalism, the new methodological individualism, and the macro-micro link, will be covered briefly.]

**R SOC 606 Contemporary Sociological Theories of Development**

Spring. 3 credits. T R 2:55-4:10. Staff. Development is now understood to include life expectancy, health and education in addition to material well-being, and it remains a problem everywhere, in both the rich and poor countries, and within them, for regions and communities. Sociological explanations of development have recently crystallized around three competing positions: political economy, rational choice institutionalism, and sociological structuralism. The course will focus on these theories, their antecedents and close cousins, and their research and policy implications.

**R SOC 609 Population and Environment**

Spring. 3 credits. T R 10:10-11:25. J. M. Stycos.

A voluminous new literature is emerging, attempting to trace the connections between population dynamics and environmental change. The seminar will be devoted to a critical examination of this literature, stressing population change both as cause and consequence of environmental factors. In addition, the social and economic forces that mediate the population-environment relation will be examined.

**R SOC 618 Research Design I**

Fall. 4 credits. Prerequisite: a statistics course. Offered alternate years.

T R 12:20-2:15. J. D. Francis.

First of a two-semester sequence (may be taken individually) in introductory graduate methods. Discusses problems of measurement, the design of instruments, and problems of reliability and validity. Common forms of measuring instruments are discussed. Concludes with an introduction to factor analysis. Students apply principles to development of several common types of scales. Computers will be used extensively.

**R SOC 619 Research Design II**

Spring. 4 credits. Prerequisite: an introductory methods course and a statistics course. Offered alternate years.

T R 12:20-2:15. J. D. Francis.

The second part of the two-semester sequence in introductory graduate methods, with emphasis on an intermediate-level treatment of the following topics: regression, analysis of variance, analysis of covariance. Special attention is given to use of categorical variables in regression. Students develop and examine several analytical models using actual data to familiarize themselves with data handling and processing. Extensive use of computers.

**[R SOC 625 State, Economy, and Society**

Spring. 3 credits. Offered alternate years. Not offered spring 1997 and 1999; next offered spring 1998. W 1:25-4:25.

P. D. McMichael.

Reviews major issues concerning the relations between political and economic institutions and the role of states, markets, firms, social movements, and cultural institutions in the process of social change. Theoretical perspectives are drawn from classical and modern social theory, including the application of comparative and historical methodologies. Substantive themes concern debates about the trajectories and crises of capitalism and socialism and the modern world economy.]

**[R SOC 630 Field Research Methods and Strategies**

Fall. 3 credits. Not offered fall 1996; next offered fall 1997. T R 8:40-9:55.

L. B. Williams.

Course will cover a variety of methods: structured surveys, focus groups, in-depth interviews, participant observation, archival record analysis, among others. Frameworks by which research questions can be matched with appropriate field methodologies, choice of sample, data collection, etc., will be discussed. Assessment of strengths and weakness of various strategies of field research. Discussion of practical matters such as fieldworker recruitment and training, and data processing issues and ethnics of field work.]

**[R SOC 640 Community and Changing Property Institutions**

Fall. 3 credits. Offered alternate years. Not offered fall 1997 and 1999; next offered fall 1998. R 1:25-4:25.

C. C. Geisler.

The seminar acquaints students with the evolution of property rights, from antiquity to the present, and features a number of property debates (the biological basis of ownership; private versus public ownership; property and value; the so-called "tragedy of the commons"; the "new" property). Readings

explore land use regulation and property rights, common property issues, opposing land ethics, and new property forms in the future.]

**[R SOC 641 Politics and Economics of Rural and Regional Development**

Fall. 3 credits. Limited to upperclass or graduate students. S-U grades optional. Offered alternate years. Not offered fall 1996 and 1998; next offered fall 1997.

M 12:20-2:50. T. A. Lyson.

A survey of social, political, and economic factors in regional development. Theories of regional development and underdevelopment are explored. The neoclassical paradigm is offered as a benchmark against which other more "structural" alternatives can be compared. The politics of rural and regional development are explored through sets of readings dealing with industrial policy.]

**[R SOC 643 Land Reform Old and New**

Spring. 3 credits. Offered alternate years.

S-U grades optional. Not offered spring 1997 and 1999; next offered spring 1998.

R 1:25-4:25. C. C. Geisler.

Land reform continues to be a major cornerstone of development planning. Between 1980 and 2000 the number of landless and near-landless in the Third World will approach one billion. Though land reform is a principal source of hope for the landless, its meanings are many and its models are controversial. The seminar acquaints students with land reform in antiquity as well as in contemporary settings (among others, Japan, the Philippines, Israel, India, Brazil, Mexico, Russia, and the United States). Perennial issues of equity, efficiency, and sustainability will be discussed in each of these case study areas.]

**[R SOC 645 Rural Economy and Society**

Fall. 3 credits. Offered alternate years.

Not offered 1996-97. T 1:25-4:25.

S. Feldman.

The structure and dynamics of rural communities are examined in a comparative historical framework focusing on continuities and divergences among advanced and post colonial settings. Major topics include classical theories of rural social organization and their retheorization in contemporary peasant studies and agrarian political economy literatures, theorizations of locality, rurality and spatial complexity within the world economy, and critical issues framing the relationship between political and labor market restructuring and petty commodity and household production systems.]

**R SOC 655 Advanced Techniques of Demographic Analysis**

Spring. 3 credits. Prerequisites: CEH 606, graduate standing or permission of instructor. M 7:30-10:30 p.m.

D. T. Gurak.

An examination of analytical techniques that assumes a basic knowledge of demographic data and research methodology. Life tables, demographic estimates with incomplete data, survey techniques to supplement inadequate vital registration systems, data management, multi-level models, and other multivariate procedures are among the topics to be covered.

**R SOC 660 Social Analysis of Ecological Change**

Spring. 3 credits. Offered alternate years.

Prerequisite: graduate standing or permission of instructor. T 9:05-12:05.

P. Taylor.

Scientific studies of ecological and social processes, together with the interpretation of those studies by historians, sociologists, and anthropologists. Topics include ideas of nature, colonial conservation science, systems ecology, the tragedy of the commons, neo-Malthusianism, human ecology, local knowledge, nomadic pastoralism, political ecology, women and eco-development, and global environmental discourse.

**[R SOC 661 Sustainable Agriculture and Development**

Fall. 3 credits. S-U grades optional.

Offered alternate years. Not offered fall 1996 and 1998; next offered fall 1997.

Prerequisites: graduate standing or instructor's permission. W 1:25-4:25.

T. A. Lyson.

This course examines the relationship between local agriculture and development as these are embedded in a globalizing economy. Topics include an examination of the social scientific theoretical underpinnings of conventional agriculture, the social origins of sustainable agriculture, environmental and community sustainability, agricultural diversification strategies, and the political and policy contexts of more sustainable agricultural systems.]

**R SOC 671 Epistemological Challenges to Social Science Paradigms: A Feminist Inquiry (also Women's Studies 671)**

Spring. 3 credits. Offered alternate years.

R 1:25-4:25. S. Feldman.

Employing a sociology of knowledge perspective and comparative approach within the social sciences, this course will review and analyze contemporary themes in the feminist epistemological critique of sociological methods. It will begin by identifying what constitutes mainstream explanations within the social sciences, introduce early feminist challenges to androcentric paradigms, move to examine the philosophical and post-modern challenge, and outline issues critical to "doing fieldwork." We will examine studies which address issues of class, race ethnicity and constructions of otherness.

**R SOC 675 Global Patterns of International Migration**

Fall. 3 credits. Offered alternate years.

M 7:30-10:30 p.m. M. M. Kritz.

International migration to the United States and other countries has increased in recent decades. What accounts for that trend in an era when large-scale international migration is supposed to have ended and what are the implications of immigration for receiving countries? Theories and research on these issues are examined in the course from a comparative and interdisciplinary perspectives. Several migration systems are examined, including those of North America and the European Community. Policies shaping immigration are also reviewed.

**R SOC 694 Special Topics in Rural Sociology**

Fall or spring. 4 credits maximum.

S-U grades optional.

The department teaches "trial" courses under this number. Offerings vary by semester, and

will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

#### **R SOC 715 Comparative Research Methods**

Fall. 3 credits. Offered alternate years.  
M 12:20-2:50. T. A. Lyson.

This seminar focuses on the comparative method in the social sciences. The logic of comparative inquiry forms the substantive base of the course. Topics include cross-national and cross-regional research design and an analysis of the comparative case study approach. Illustrations of the comparative research approach will cover a range of data types and problems.

#### **[R SOC 718 Multidimensional Measurement and Classification**

Fall. 4 credits. Prerequisite: previous course work in scaling and statistics.  
Offered alternate years. Not offered fall 1996 and 1998; next offered fall 1997.  
T R 12:20-2:15. J. D. Francis.

An advanced course in measurement and scaling, building from work by Thurstone, Guttman and Coombs to multidimensional measurements. Topics include philosophy of factor analysis, factor-analysis models, factoring design, factoring techniques, and comparison with factor-analysis models. Cluster analysis and multidimensional scaling are the other major techniques discussed. As matrix algebra is an integral part of these procedures, class time is devoted to this topic. Computers are used to analyze fit to models.]

#### **[R SOC 719 Logistic and Log Linear Models**

Spring. 4 credits. Prerequisites: two courses in statistics and one in methods.  
Offered alternate years. Not offered spring 1997 and 1999; next offered spring 1998.  
T R 12:20-2:15. J. D. Francis.

The first part of the course reviews multiple regression theory and procedures, after which extensions of these models to categorical data are discussed. Consideration is given to violations of assumptions and their effects. Then more advanced regression concepts and estimation techniques are discussed. The main focus of the course is on logit and log linear models. Computerized labs are an integral part of the course.]

#### **R SOC 721 Sociology of Environment and Development**

Fall. 3 credits. Offered alternate years.  
S-U optional. W 10:10-12:35.  
M. J. Pfeffer.

This course examines society/environment relations in the contemporary environmental discourse and in sociology. Students evaluate such topics as sustainability, science and ethics, and the definition of nature. The central objective is to evaluate sociological theories' treatment of the problems of environmentalism. Subsidiary objectives include the identification of key sociological issues in contemporary environmentalism, and review of environmental themes in sociological theory.

#### **R SOC 725 The Sociology of "Third World" States**

Fall. 3 credits. Offered alternate years.  
T 1:25-4:25. S. Feldman.

This course examines how processes of political and economic restructuring have

reshaped state capacities and processes of state formation. Particular attention is paid to questions of class formation, corporatist alliances, transnational interests, and alternative development strategies with the emergence of austerity, privatization and trade liberalization and its neoliberalist ideology. Critical to this discussion are the contours of authoritarianism, nationalism, communalism and fundamentalism as these reconfigure national and regional alliances and practices.

#### **R SOC 730 Sociology of the World Economy**

Spring. 3 credits. S-U grades optional.  
Offered alternate years. W 1:25-4:25.  
P. D. McMichael.

Analyses of social change and development are increasingly sensitive to global context, including the sociology of the world economy as a multi-layered entity, anchored in an evolving division of world labor and interstate system. The analysis of transnational economic and cultural processes (such as food regimes, commodity chains, and international labor complexes), has substantive and methodological dimensions, considering a variety of levels and kinds of analysis of global processes. This includes global theories (and their limits), and methods of situating local processes within their world-historical context.

#### **[R SOC 741 Community Development and Local Control**

Spring. 3 credits. Offered alternate years.  
Not offered 1996-97. W 1:25-4:25.  
C. C. Geisler.

Theories of community growth and decline and the current debate over the place of local control in community development in general are considered. Salient themes include the role of neopopulism in community development, changing institutions of property as community development occurs, and changing definitions of "community."]

#### **R SOC 771 Special Seminar**

Fall or spring. Credit to be arranged.  
Limited to graduate students; others by permission of instructor.

#### **R SOC 791 Teaching Experience**

Fall or spring. 1-3 credits. Limited to graduate students. S-U grades only.  
Participation in the ongoing teaching program of the department.

#### **R SOC 792 Public Service Experience**

Fall or spring. Credit to be arranged.  
Limited to graduate students. S-U grades optional.

Participation in the ongoing public service activities of the department.

#### **R SOC 800 Master's-Level Thesis Research**

Fall or spring. Credit to be arranged.  
Prerequisite: permission of instructor.  
S-U grades optional. Graduate faculty.

For students admitted specifically to a Master's program.

#### **R SOC 871-874 Informal Study**

Fall or spring. Credit to be arranged.  
Limited to master's and doctoral degree candidates with permission of the graduate field member concerned. S-U grades optional.

#### **R SOC 871 Rural Sociology**

#### **R SOC 872 Development Sociology**

#### **R SOC 873 Organization Behavior and Social Action**

#### **R SOC 874 Methods of Sociological Research**

#### **R SOC 900 Graduate-Level Thesis Research**

Fall or spring. Credit to be arranged.  
Prerequisite: permission of instructor.  
S-U grades optional. Graduate faculty.  
For students in a Ph.D. program **only before** the "A" exam has been passed.

#### **R SOC 901 Doctoral-Level Thesis Research**

Fall or spring. Credit to be arranged.  
Prerequisite: permission of instructor.  
S-U grades optional. Graduate faculty.  
For students admitted to candidacy **after** the "A" exam has been passed.

### **Related Courses in Other Departments**

(Others may be added)

Introduction to Sociology (SOC 101)

Population Dynamics (SOC 205)

Social Analysis of Ecological Change (S&TS 660 and B&SOC 460)

Population Policy (B SOC 414)

Gender Relations, Gender Ideologies, and Social Change (WMNS 524)

### **Summer Session Courses**

Introduction to Sociology (6-week session)

Environment and Society (3-week session)

Successful Aging: Today and Tomorrow (3-week session)

## **SOIL, CROP, AND ATMOSPHERIC SCIENCES**

J. M. Duxbury, chair; M. Alexander, P. C. Baveye, D. R. Bouldin, R. B. Bryant, J. H. Cherney, S. J. Colucci, K. H. Cook, W. J. Cox, S. D. DeGloria, E. C. Fernandes, G. W. Fick, D. L. Grunes, R. R. Hahn, J. L. Hutson, S. D. Klausner, W. W. Knapp, L. V. Kochian, T. A. LaRue, M. B. McBride, J. Mt. Pleasant, R. L. Obendorf, W. D. Pardee, J. H. Peverly, W. S. Reid, S. J. Riha, T. W. Scott, T. L. Setter, P. L. Steponkus, H. M. van Es, A. Van Wambeke, R. J. Wagenet, R. M. Welch, D. S. Wilks, M. W. Wysocki, R. W. Zobel

**Note: class meeting times are accurate at the time of publication. If changes are necessary, the department will provide new information as soon as possible.**

### **Courses by Subject**

Atmospheric Science: 101/102, 131, 250, 331, 332, 334, 341, 342, 352, 353, 435, 444, 446, 447, 451, 456, 457, 635, 646, 652, 692, 850, 950, 951

Crop Science: 311, 312, 314, 315, 317, 608, 610, 612, 613, 614, 642, 690, 691, 820, 920, 921

Environmental Information and Analysis: 420, 461, 620, 660, 675

Soil Science: 260, 321, 362, 363, 364, 365, 371, 372, 373, 385, 471, 473, 483, 663, 666, 667, 669, 671, 681, 693, 880, 980, 981



## General Courses

### SCAS 190 Sustainable Agriculture

Fall. Credits variable, 2 or 3. Limited to 60 students. S-U grades optional. Lec, R 10:10; labs, M 2:00-4:25, T 10:10-12:35. G. W. Fick.

This course is designed to be an enjoyable introduction to basic food production resources (soils, crops, and climates), and it emphasizes management concepts that conserve or renew those resources for continuing benefit to society. The information is of general value for non-majors and students new to the field. Laboratories include several field trips and stress hands-on experience with soils, crops, and descriptive climatology. Written assignments are prepared for the World Wide Web. An extra credit can be earned by participation in team preparation and delivery of a lesson in sustainable agriculture.

### SCAS 494 Special Topics in Soil, Crop and Atmospheric Sciences (undergraduate level)

Fall or spring. 4 credits maximum. S-U grades optional.

The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department. Courses offered under the number are approved by the department curriculum committee, and the same course is not offered more than twice under this number.

### SCAS 497 Individual Study in Soil, Crop, and Atmospheric Sciences

Fall or spring. 1-6 credits. S-U grades optional. Students must register with an Independent Study form (available in 140 Roberts Hall).

The topics in soil science or crop science or atmospheric science are arranged at the beginning of the term for individual study or for group discussions.

### SCAS 498 Teaching Experience in Soil Science, Crop Science, and Atmospheric Science

Fall or spring. 1-5 credits. Students must register with an Independent Study form (available in 140 Roberts Hall). S-U grades optional.

Teaching experience in soil science, crop science, or atmospheric science is obtained by assisting in the instruction of a departmental course.

### SCAS 499 Undergraduate Research

Fall or spring. Credit to be arranged. Students must register with an Independent Study form (available in 140 Roberts Hall).

Independent research on current problems selected from any phase of crop science, atmospheric science, or soil science.

### SCAS 694 Special Topics in Soil, Crop and Atmospheric Sciences (graduate level)

Fall or spring. 4 credits maximum. S-U grades optional.

The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department. Courses offered under the number are approved by the department curriculum committee, and the same course is not offered more than twice under this number.

### SCAS 695 Planning and Reporting Research

Spring. 2 credits. Prerequisite: graduate student status or permission of the instructor. Limited to 10 students. Lec to be announced. G. W. Fick.

This course is designed to prepare students in the SCAS Department and closely related fields for planning their research and reporting research results. Emphasis is given to literature reviews, scientific writing and reviewing (either thesis proposals, grant proposals, or manuscripts for publication), and slide and poster presentations. Students are expected to work closely with their major professor as well as the instructor of the course.

## Atmospheric Science

### SCAS 101/102 Science of Earth Systems Colloquium (also ABEN 120/121, GEOL 123/124)

Fall and spring. 2 credits. Lec, T 1:25-4:10. K. H. Cook.

Weekly one-hour seminars followed by discussion of current topics in the study of the earth system. Introduces the student to scientific issues relating to understanding our planet and managing the environment. See "Interdisciplinary Centers, Programs, and Studies" in the introductory section of the catalog for a complete description of a new program in the Science of Earth Systems.

### SCAS 131 Basic Principles of Meteorology

Fall. 3 credits. Lects, T R 11:15; lab, T W or R 1:25-4:25 and M W 7:00-9:30 p.m. M. W. Wysocki.

A simplified treatment of the structure of the atmosphere: heat balance of the earth; general and secondary circulations; air masses, fronts, and cyclones; and hurricanes, thunderstorms, tornadoes, and atmospheric condensation. In the laboratory, emphasis is on techniques of analysis of weather systems.

### SCAS 250 Meteorological Observations and Instruments

Spring. 3 credits. Prerequisite: SCAS 131. Lects, M W 12:20; lab, W 1:25-3:20. M. W. Wysocki.

Methods and principles of meteorological measurements and observations, including surface, free-air, and remote systems. Instrument siting, mounting, and protection. Instrument response characteristics, calibration, and standardization. Recorders and data-logging systems. Laboratory exercises in observation and data analysis. Intended to serve as preparation for Observers Examination. Lab fee, \$45.

### SCAS 331 Climate Dynamics (also ASTRO 331)

Fall. 4 credits. Prerequisites: MATH 112 or 192 or equivalent. Lects, M W F 11:15-12:05; disc, R 1:25. K. H. Cook, P. J. Gierasch.

Processes that determine climate and contribute to its change are discussed, including comparisons with climates of other planets. Applications to problems of climate change and variability include the astronomical theory of ice ages, greenhouse warming, the ozone hole, African drought, and Amazonian deforestation.

### SCAS 332 Evolution of the Earth System (also SES 302, GEOL 302)

Spring. 4 credits. Prerequisites: MATH 112 or 192 and CHEM 207 or equivalent. Lects, M W F 11:15-12:05; disc, T 1:25. B. Isacks and others.

Co-evolution of life and the earth system: Earth's early history; plate tectonics, continental drift and climate changes during the past billion years; mountain building, ice ages, and our own emergence during the past ten million years. Introduction to methods of interpreting information preserved in the rock record.

### SCAS 334 Microclimatology

Spring. 3 credits. Recommended: a course in physics. T R 10:10-11:25. D. S. Wilks.

The relationships of radiant energy, temperature, wind, and moisture in the atmosphere near the ground. The interplay between physical processes of the atmosphere, plant canopies, and soil is examined, with emphasis on the energy balance.

### SCAS 341 Atmospheric Thermodynamics and Hydrostatics

Fall. 3 credits. Prerequisites: one year of calculus and one semester of physics. M W F 9:05-9:55. W. W. Knapp.

Introduction to the thermodynamics and hydrostatics of the atmosphere and to the methods of description and quantitative analysis used in meteorology. Topics covered include thermodynamic processes of dry air, water vapor and moist air, and concepts of hydrostatics and stability.

### SCAS 342 Atmospheric Dynamics

Spring. 3 credits. Prerequisites: one year each of calculus and physics. M W F 10:10. W. W. Knapp.

Introduction to atmospheric dynamics and to the methods of description and quantitative analysis used in meteorology. Topics considered include equations of atmospheric motion, motion in the free atmosphere, vertical variations of wind and pressure fields, mathematical representation and characteristics of fronts, mechanisms of pressure change, concepts of circulation and vorticity, and effects of friction on atmospheric motion.

### SCAS 352 Synoptic Meteorology I

Spring. 3 credits. Prerequisites: SCAS 341 and concurrent enrollment in SCAS 342. Lects, T R 9:05; lab, M 1:25-3:25. M. W. Wysocki.

Weather map analysis and forecasting techniques are studied by applying the principles of fluid and heat flow. This course will strengthen previously introduced meteorological concepts that will be applied to forecasting mid-latitude synoptic scale weather systems, such as cyclones, anticyclones, jet streams, fronts, and waves.

### SCAS 353 Application of FORTRAN in Meteorology

Fall. 3 credits. Prerequisites: SCAS 131 plus one computer programming course. Lec, T R 12:20-1:10; lab, F 1:25-3:20. M. W. Wysocki.

An introduction to numerical techniques using FORTRAN to solve meteorological problems. No previous experience with FORTRAN is expected.

**SCAS 435 Statistical Methods in Meteorology**

Fall. 3 credits. Prerequisite: an introductory course in statistics (e.g., BTRY 215 or ARME 310) and calculus. T R 10:10-11:25. D. S. Wilks.

Statistical methods used in climatology, operational weather forecasting, and selected meteorological research applications. Some statistical characteristics of meteorological data, including probability distributions, intercorrelations, and persistence. Operational forecasts derived from multiple regression models, including the MOS system. Forecast verification techniques and scoring rules. Time series analysis, EOFs, and other research topics as time permits.

**[SCAS 444 Tropical Meteorology]**

Spring. 3 credits. Prerequisites: SCAS 342 or instructor's approval. Offered alternate years. Not offered 1996-97; next offered spring 1998. M W F 11:15-12:05. K. H. Cook.

Structure and dynamics of the tropical atmosphere on a wide range of time and space scales ranging from meso-scale convective systems to planetary waves. Topics include hurricanes, monsoonal circulation, and El Nino.]

**SCAS 446 Modeling the Earth System**

Spring. 3 credits. Prerequisites: Programming knowledge and instructor's approval. Offered alternate years. Offered 1996-97. T R 12:20-1:35. K. H. Cook.

Project-oriented exploration of aspects of the Earth System through computer modeling. Intended primarily for science majors with computing experience, preferably in FORTRAN. Lectures focus on facilitating student projects, discussing basic concepts governing the Earth system dynamics, and evaluating complex models. Students develop a model on a topic of their choice.

**[SCAS 447 Physical Meteorology]**

Fall. 3 credits. Prerequisites: a year each of calculus and physics. Offered alternate years. Not offered fall 1996; next offered fall 1997. M W F 11:15. W. W. Knapp.

Primarily a survey of natural phenomena of the atmosphere, with emphasis on their underlying physical principles. Topics include composition and structure of the atmosphere, atmospheric optics, acoustics and electricity, solar and terrestrial radiation, and principles of radar probing of the atmosphere.]

**SCAS 451 Synoptic Meteorology II**

Fall. 3 credits. Prerequisites: SCAS 341 and SCAS 342. Lects, T R 9:05; lab, M 1:25-3:20. S. J. Colucci.

Structure and dynamics of large-scale mid-latitude weather systems, such as cyclones, anticyclones and waves, from the perspective of a quasigeostrophic model of the atmosphere.

**[SCAS 456 Mesoscale Meteorology]**

Spring. 3 credits. Prerequisites: SCAS 341 and SCAS 342 or permission of instructor. Offered alternate years. Not offered spring 1997; next offered spring 1998. T R 12:20-1:35. S. J. Colucci.

Structure and dynamics of mid-latitude mesoscale weather systems such as fronts, jets, squall lines, convective complexes, precipitation bands, downslope windstorms, mountain breezes, sea breeze circulations, and lake effect snowstorms.]

**SCAS 457 Atmospheric Air Pollution**

Fall. 3 credits. Prerequisites: SCAS 341 or one course in Thermodynamics and one semester of chemistry or permission of instructor. Offered alternate years. Offered 1996-97. M W F 11:15-12:05. M. W. Wysocki.

Course will examine sources, effects, transport, measurement, and controls of air pollution. The basic principles in each area will be discussed with an emphasis on their local, regional, and global impacts.

**SCAS 635 Advanced Statistical Meteorology**

Fall. 3 credits. Prerequisites: coursework in or elementary knowledge of statistics, calculus, matrix algebra, and computer programming. Lec, T R 10:10-11:25, R 11:35-12:05. D. S. Wilks.

Lectures and topics concurrent with SCAS 435, plus an extra 30-minute session per week in which selected topics from SCAS 435 are treated in more depth, and additional topics are covered which may vary from year to year according to student interest. Term project required.

**SCAS 646 Modeling the Earth System**

Spring. 3 credits. Prerequisite: instructor's approval. Offered alternate years. Offered spring 1997. T R 12:20-1:35. K. H. Cook.

Lectures concurrent with SCAS 446 (see description). Graduate students have different problem sets and more sophisticated projects.

**SCAS 652 Advanced Atmospheric Dynamics**

Spring. 3 credits. Prerequisites: SCAS 341 and SCAS 342 or permission of instructor. Offered alternate years. Offered spring 1997. M W F 11:15-12:05. S. J. Colucci.

Quasigeostrophic theory, atmospheric waves, hydrodynamic instability, the general circulation of the atmosphere, and topics selected from among numerical weather prediction and tropical, mesoscale, and middle atmosphere processes according to student interest.

**SCAS 692 Special Topics in Atmospheric Sciences**

Fall or spring. 1-6 credits. S-U grades optional.

Study of topics in atmospheric science that are more specialized or different from other courses. Special topics to be covered will depend on staff and student interests.

**SCAS 850 Master's-Level Thesis Research in Atmospheric Sciences**

Fall or spring. Credit by arrangement. S-U grades only. Hours by arrangement. Graduate faculty.

Limited to students specifically in a master's program.

**SCAS 950 Graduate-Level Dissertation Research in Atmospheric Sciences**

Fall or spring. Credit by arrangement. S-U grades optional. Hours by arrangement.

Limited to students in a Ph.D. program only before the "A" exam has been passed.

**SCAS 951 Doctoral-Level Dissertation Research in Atmospheric Sciences**

Fall or spring. Credit by arrangement. S-U grades optional. Hours by arrangement. Graduate faculty.

Limited to students admitted to candidacy after the "A" exam has been passed.

**Crop Science****SCAS 311 Grain Crops**

Fall. 4 credits. Prerequisite: SCAS 260 or BIOPL 241. Lects, M W F 10:10; lab, M 1:25-4:25. 1 or 2 field trips during lab periods (until 5 p.m. or on weekends)! R. L. Obendorf.

Principles of field-crop growth, development and maturation, species recognition, soil and climatic adaptations, liming and mineral nutrition, weed control, cropping sequences, management systems, and crop improvement are considered. Grain, protein, oil, fiber, and sugar crops are emphasized. Laboratory utilizes living plants, extensive crop garden, and computer simulation.

**SCAS 312 Forage Crops**

Spring. 4 credits. Prerequisites: SCAS 260 or BIOPL 241 or equivalent. Recommended: AN SC 212. Lects, M W F 11:15; lab, M or T 1:25-4:25. G. W. Fick.

The production and management of crops used for livestock feed are considered in terms of establishment, growth, maintenance, harvesting, and preservation. Forage grasses, forage legumes, and corn are emphasized, and consideration is given to their value as livestock feed in terms of energy, protein, and other nutritional components.

**SCAS 314 Production of Tropical Crops**

Spring. 3 credits. Offered 1996. Hours to be announced. E. C. Fernandes.

An introduction to major tropical cropping systems, their characteristics and management for sustainability.

**SCAS 315 Weed Science**

Fall. 3 credits. Prerequisite: introductory course in biology or botany. Lects, T R 9:05; lab, T W 2-4:25. Staff.

Principles of weed science are examined. Emphasis is on (a) weed ecology, (b) chemistry of herbicides in relation to effects on the environment and plant growth, and (c) control of weeds in crops. Laboratory covers weed identification and ecology, herbicide selectivity, symptomology, and behavior in soil.

**[SCAS 317 Seed Science and Technology]**

Fall. 3 credits. Prerequisite: BIOPL 241 or equivalent. Offered alternate years. Not offered fall 1996; next offered fall 1997. Lects, T R 11:15; lab, R 1:25-4:25. 2 all-day field trips will be scheduled during the semester. A. G. Taylor, Geneva Experiment Station. (Ithaca contact, R. L. Obendorf.)

The principles and practices involved in the production, harvesting, processing, storage, testing, quality management, certification, and use of high-quality seed from improved cultivars. Information is applicable to various kinds of agricultural seeds. Hands-on laboratory experience.]

**SCAS 608 Water Status in Plants and Soils**

Fall. 1 credit. Prerequisite: permission of instructor. S-U grades only. Offered alternate years. Offered fall 1996.

Lec, 1 hour to be arranged; lab, R 1:25-4:25 or as arranged. T. L. Setter.

Techniques for field appraisal of the status of water in plants and soil, including methods used in physiological studies, such as the psychrometer, pressure chamber, gas exchange analyzer, and abscisic acid analysis with ELISA.

**[SCAS 610 Physiology of Environmental Stresses]**

Spring. 3 credits. Prerequisite: BIOPL 242 or 341. Offered alternate years. Not offered spring 1997; next offered spring 1998. Lects, T R 10:10–11:25. P. L. Steponkus.

A study of the responses of plants to environmental stresses, with emphasis on thermal stresses including chilling, freezing, and high temperature injury. Emphasis is on the physiological and biochemical basis of injury and plant resistance mechanisms at the whole-plant, cellular, and molecular levels.]

**[SCAS 612 Seed Physiology]**

Spring. 3 credits. Prerequisite: plant physiology. Not offered spring 1997. T R 8:30–9:55. R. L. Obendorf.

Morphology, physiology, and biochemistry of cereal, legume, and oil-seed formation, composition, storage, and germination. Emphasis is on the deposition of seed reserves during seed formation, stabilization of reserves during storage, and mobilization of reserves during germination. Topics range from on-farm problems to molecular mechanisms.]

**[SCAS 613 Physiology and Ecology of Yield]**

Spring. 3 credits. Prerequisite: plant physiology. M W F 12:20. T. L. Setter.

A study of the constraints on crop productivity from a physiological perspective. Influence of environment and genetics on the assimilation, translocation, and partitioning of carbon and nitrogen during crop ontogeny. Emphasis on growth processes of vegetative plant organs.

**[SCAS 614 Research Methods in Weed Physiology]**

Spring. 2 credits. Prerequisite: SCAS 315 or equivalent. Offered alternate years. Not offered spring 1997. Staff.

Examination of a variety of modern techniques used to study herbicide absorption, translocation, metabolism, mode of action, and mechanism of resistance. Experiments will also be designed to study herbicide behavior and detection in soils. Laboratories will be accompanied by short lectures pertinent to experimental topics.]

**[SCAS 642 Plant Mineral Nutrition (ALSO BIO PL 642)]**

Spring. 3 credits. Prerequisite: BIO PL 341 or equivalent. Offered alternate years. Offered spring 1997. Lects, M W F 10:10–11. L. V. Kochian, R. M. Welch.

A detailed study of the processes by which plants acquire and utilize mineral nutrients from the soil. Topics will include the uptake, translocation, and compartmentation of mineral elements; root-soil interactions; metabolism of mineral elements; the involvement of mineral nutrients in various physiological processes; and nutrition of plants adapted to extreme environmental stresses (e.g., acid soils). Specific mineral elements will be emphasized to illustrate the above topics.

**[SCAS 690 Root-Soil Interactions]**

Fall or spring. 1–2 credits. S-U grades optional. Hours to be arranged. R. W. Zobel.

A topic dealing with root-soil interaction will be selected during the first meeting of the term. Students will prepare one or two seminars based on published work on the topic. Possible topics include root genetics, root morphology, conservation tillage, and soil temperature.

**[SCAS 691 Special Topics in Crop Science]**

Fall or spring. 1–6 credits. S-U grades optional. Hours to be arranged. Staff. Study of topics in crop science that are more specialized or different from other courses. Special topics to be offered will depend on staff and student interests.

**[SCAS 820 Master's-Level Thesis Research in Crop Science]**

Fall or spring. Credit by arrangement. S-U grades only. Hours by arrangement. Graduate faculty.

Limited to students specifically in a master's program.

**[SCAS 920 Graduate-Level Thesis Research in Crop Science]**

Fall or spring. Credit by arrangement. S-U grades only. Hours by arrangement. Graduate faculty.

Limited to students in a Ph.D. program only before the "A" exam has been passed.

**[SCAS 921 Doctoral-Level Dissertation Research in Crop Science]**

Fall or spring. Credit by arrangement. S-U grades only. Hours by arrangement. Graduate faculty.

Limited to students admitted for candidacy after the "A" exam has been passed.

**Environmental Information and Analysis****[SCAS 420 Geographic Information Systems]**

Fall. 3 credits. Prerequisite: instructor's approval. Lects, T R 9:05–9:55; lab, M T 1:25–4:25. S. D. DeGloria.

Principles and applications of geographic information systems used for environmental assessment and economic development programs. Methods for accessing, updating, analyzing, and mapping spatial data and information are emphasized. Needs assessment, database design and maintenance, data transformations, and map accuracy assessment are considered.

**[SCAS 461 Resource Inventory Methods (also Civil and Environmental Engineering 411)]**

Spring. 3 credits. Prerequisite: permission of instructor. Not offered 1996–97. S. D. DeGloria.

A survey of resource inventory methods applied to field-based studies of environmental systems. Laboratory emphasis is on using maps, spatial databases, global positioning systems, and aerospace imagery to discriminate, measure, inventory, and monitor environmental resources.]

**[SCAS 620 Spatial Modeling and Analysis]**

Spring. 3 credits. Prerequisites: SCAS 420 or permission of instructor. Lects, T R 9:05–9:55; lab, T 1:25–4:25. S. D. DeGloria.

Theory and practice in the development, integration, and scientific visualization of spatial data for environmental process modeling, land classification and evaluation, and resource inventory and analysis. Application and evaluation of spatial analytical methods applied to environmental systems and databases of interest to the student are emphasized.

**[SCAS 660 Remote Sensing Fundamentals (also Civil and Environmental Engineering 610)]**

Fall. 3 credits. Prerequisite: permission of instructor. Lects, T R 12:20–1:10; lab, R 1:25–3:20. W. D. Philpot.

An introduction to equipment and methods used in obtaining information about earth resources and the environment from aircraft or satellite. Coverage includes sensors, sensor and ground-data acquisition, data analysis and interpretation, and project design.

**[SCAS 675 Application of Soil-Plant-Atmosphere Models]**

Spring. 3 credits. Prerequisite: SCAS 483 or equivalent and COM S 100 or equivalent. Offered alternate years. Not offered spring 1997; next offered spring 1998. Lects, T R 1:25–2:45. S. J. Riha, J. L. Hutson.

Introduction to selection and use of soil-plant-atmosphere models. Topics covered will include problem analysis, general and specific types of models in current use, how to obtain and process data required to parameterize and drive models, and how to critically evaluate and present model output. The course will use a case study approach in which different models are used to address a number of current agricultural and environmental problems. Strengths and weaknesses in the use of soil-plant-atmosphere models for teaching, research, extension and policy formation will be discussed.]

**Soil Science****[SCAS 260 Introduction to Soil Science]**

Spring. 4 credits. Prerequisite: CHEM 103, 207 or 215. S-U grades optional. Lects, M W F 9:05; lab, M T W or R 1:25. R. B. Bryant.

A comprehensive introduction to the field of soil science, with emphasis on scientific principles and their application to solving soil management problems. The laboratory exercises stress quantitative measurement of soil properties.

**[SCAS 321 Soil and Water Management]**

Spring. 3 credits. Prerequisites: SCAS 190 or 260. S-U grades optional. Lects, T R 11:15–12:05; lab, R 2:30–4:30. H. M. van Es.

Course intended to introduce students to the principles of soil and water interaction and to the effects of human intervention in these processes. Aspects of soil and water management, including hydrology, soil erosion, water management, contaminant movement, tillage, and water quality are examined. Case studies and policy approaches from both the United States and abroad are discussed.

**[SCAS 362 Soil Morphology]**

Fall. 1 credit. Undergraduates only. Recommended for sophomores and juniors. R. 1:25–4:25; all day field trip required. R. B. Bryant and J. M. Galbraith. The principles for field identification of soil properties, profiles, and landscapes are presented. A series of soil pits are examined, described, classified, and interpreted in the field.

**SCAS 363 Intermediate Soil Science I: Genesis, Classification, and Survey**

Fall, weeks 1-7. 2 credits. Prerequisite: SCAS 260. Lec, M W F 10:10; lab, W 1:25-4:25. One all day field trip is required. R. B. Bryant.

Factors and processes of soil formation. Principles of field identification, classification, survey, and interpretation. Laboratory exercises and field trips provide practical training in soil morphology and landscape relations. Course ends at mid-semester and is part of a sequence of three Intermediate Soil Science courses.

**SCAS 364 Intermediate Soil Science II: Physics**

Fall, weeks 8-14. 2 credits. Prerequisites: SCAS 260, one year of calculus and consent of instructor. Lec, M W F 10:10; lab, W 1:25-4:25. P. C. Baveye.

Description and measurement of the status of water in soils. Theory of water, solute, and heat transport. Infiltration, drainage, and redistribution. Weekly laboratory and problem-solving sessions illustrate the concepts introduced in class. Course starts at mid-semester and is part of a sequence of three intermediate Soil Science courses.

**SCAS 365 Intermediate Soil Science III: Chemistry and Microbiology**

Spring. 3 credits. Prerequisite: SCAS 260. T R 10:10-11:30. M. B. McBride and M. Alexander.

The chemical properties and microorganisms of soil and the chemical reactions and transformations occurring in soil. This course is part of a sequence of three intermediate Soil Science courses.

**SCAS 371 Hydrology and the Environment (also ABEN 371 and GEOL 204)**

Spring. 3 credits. Students enrolled in the statutory colleges must enroll in ABEN 371 or SCAS 371. Prerequisite: 1 course in calculus. Lec, T R 9:05; lab, F 1:25-3:20. T. S. Steenhuis, J.-Y. Parlange, M. F. Walter, L. M. Cathles, P. C. Baveye.

Introduction to hydrology as a description of the hydrologic cycle and the role of water and chemicals in the natural environment. Includes precipitation, infiltration, evapotranspiration, groundwater, surface runoff, river meandering floods, and droughts. Case studies, short field trips, computer programs, and laboratories are used to foster an understanding of concepts and principles of hydrologic processes.

**SCAS 372 Soil Fertility Management**

Fall. 3 credits. Prerequisite: SCAS 260 or permission of instructor. S-U grades optional. M W F 9:05. D. R. Bouldin.

An integrated discussion of soil crop yield relationships, with emphasis on the soil as a source of mineral nutrients for crops and the role of fertilizers and manure in crop production.

**SCAS 373 Soil, Water, and Aquatic Plants**

Fall. 3 credits. Prerequisites: SCAS 260, BIO G 101-102, and CHEM 103-104 or equivalents. Lec, T R 11:15; lab, R 1:25-4:25. J. H. Peverly.

The success or failure of soil and water management is manifested in streams, wetlands, lakes, and aquifers. Chemical and biological changes downstream are studied and related to agricultural management

techniques upstream. Basic chemical and physiological processes are presented and used to suggest appropriate responses to water management problems.

**SCAS 385 Biogeochemical Cycles, Agriculture, and the Environment**

Spring. 2 credits. Prerequisites: CHEM 103 or 207 and SCAS 260 or equivalent. Lec, T R 11:15-12:05. J. M. Duxbury.

The impact of agriculture on aspects of the global biogeochemical cycles of carbon, nitrogen, sulfur, and phosphorus is discussed and illustrated with current agricultural and environmental issues. Topics include sustainable agriculture, effects of nitrogen fixation, acid rain, global warming, and land disposal of wastes.

**[SCAS 471 Properties and Appraisal of Soils of the Tropics]**

Spring. 3 credits. Prerequisite: SCAS 260 or equivalent. S-U grades optional. No audits accepted. Offered alternate years. Not offered spring 1997; next offered spring 1998. Lec, T R 12:20; disc, W 1:25-3:25. A. VanWambeke.

The course examines the conditions in which soils form, and considers ecological, geological and vegetational factors that produce the diversity that exists among them. The major kinds of soils are recognized, their management properties described, and methods to alleviate the constraints to crop production examined. Topics include the identification of soils, and their functions in sustaining traditional farming systems and advanced technological packages. The course pursues these themes reviewing the most recent sources of information generated in tropical countries and published in Latin-American, Francophone, and English journals. The last part of the course gives special attention to salt-affected soils, paddy rice cultivation and the characteristics of acid-sulfate soils.]

**SCAS 473 Ecology of Agricultural Systems (also BIOES 473)**

Fall. 3 credits. Limited to 45 students. Prerequisite: BIOES 261 or permission of instructor. S-U grades optional. Offered alternate years. Offered fall 1996. Lec and disc, T R 2:30-3:45. During the first 6 weeks of class, the Thursday meetings may run to 5:30 because of field trips. A. G. Power and staff.

Analysis of the ecological processes operating in agricultural systems, with an emphasis on the interactions between organisms. Topics include nutrient dynamics in agroecosystems, plant competition and facilitation, intercropping, the ecology of species invasions, mutualism in agroecosystems, plant-herbivore relations, plant-pathogen interactions, biological pest control, and evolutionary processes in agriculture. Case studies from both the tropics and the temperate zone are used to illustrate important concepts.

**SCAS 483 Environmental Biophysics**

Fall. 3 credits. Prerequisite: SCAS 260 or equivalent or permission of instructor. Lec, M W F 11:15. S. J. Riha.

Introduction to basic principles of energy and water transfer and storage in soil-plant systems. Energy budgets, soil heat flow, water movement in saturated and unsaturated soils, evapotranspiration, and water dynamics in the soil-plant-atmosphere continuum will be covered. Applications to agronomic and environmental problems and instrument

design and use are considered through discussion and problems sets.

**SCAS 663 Pedology**

Spring. 3 credits. Prerequisite: SCAS 361 or permission of instructor. Textbook recommended, not required. Offered odd spring semesters. R. B. Bryant.

Weathering, reactions, and processes of soil genesis. Principles of soil classification and the rationale and utilization of soil taxonomy. Development and significance of major groups of soils of the world.

**SCAS 666 Advanced Soil Microbiology**

Fall. 1 credit. Prerequisite: SCAS 365 or permission of instructor. S-U grades only for graduate students. T 12:20. M. Alexander.

Discussions of current topics in special areas of soil microbiology. Particular attention is given to biodegradation, bioremediation and fate of chemicals.

**[SCAS 667 Advanced Soil Physics]**

Spring. 3 credits. Prerequisites: One year of college physics and SCAS 483 or permission of instructor. S-U grades optional. Offered alternate years. Not offered spring 1997. Hours to be arranged. P. C. Baveye.

A detailed study of measurement processes and of the hydrostatics of aqueous solutions in soils and porous media, with emphasis on fundamental principles. Examination of the molecular aspects of water-solid interactions, including shrink-swell phenomena and the properties of absorbed water. Analysis of equilibrium water adsorption from thermodynamic and mechanistic (molecular) standpoints. Mechanical and thermodynamic analysis of the equilibrium status of aqueous solutions in deformable soils. Formal lectures are complemented by tutorial sessions.]

**SCAS 669 Organic Matter—Soils, Sediments, and Waters**

Spring. 2 or 3 (with discussion) credits. Prerequisites: SCAS 260 and CHEM 357-358 or equivalent. T R 9:05; disc, W 1:25-2:15. J. M. Duxbury.

A discussion of current concepts on the chemical nature, dynamics, and properties of natural organics and organo-mineral associations in terrestrial and aquatic environments. Interaction with anthropogenic organics and effects of anthropogenic activities on natural organics are considered.

**[SCAS 671 Soil Chemistry]**

Fall. 3 credits. Prerequisite: one year of physical chemistry or permission of instructor. Offered alternate years. Not offered fall 1996; next offered fall 1997. Lec, M W F 11:15. M. B. McBride.

A detailed examination of the structure and surface chemistry of minerals common to soils. Ion exchange, mineral-solution equilibria, and adsorption reactions of silicate clays and oxides will be emphasized.]

**SCAS 681 Soil Physics Research Seminar**

Fall. 1 credit. Open to graduate students. P. C. Baveye, J. L. Hutson, H. van Es. Discussions of current topics in special areas of soil physics and presentation of research carried out by participants.



**SCAS 693 Special Topics in Soil Science**

Fall or spring. 1-6 credits. S-U grades optional.

Study of topics in soil science that are more specialized or different from other courses. Special topics to be covered will depend on staff and student interests.

**SCAS 880 Master's-Level Thesis Research in Soil Science**

Fall or spring. Credit by arrangement. S-U grades only. Hours by arrangement. Graduate faculty.

Limited to students specifically in a master's program.

**SCAS 980 Graduate-Level Dissertation Research in Soil Science**

Fall or spring. Credit by arrangement. S-U grades only. Hours by arrangement. Graduate faculty.

Limited to students in a Ph.D. program **only** before the "A" exam has been passed.

**SCAS 981 Doctoral-Level Dissertation Research in Soil Science**

Fall or spring. Credit by arrangement. S-U grades only. Hours by arrangement. Graduate faculty.

Limited to students admitted to candidacy **after** the "A" exam has been passed.

**VEGETABLE CROPS**

See Horticultural Sciences.

**FACULTY ROSTER**

Abawi, George S., Ph.D., Cornell U. Prof., Plant Pathology (Geneva)  
 Acree, Terry E., Ph.D., Cornell U. Prof., Food Science, and Technology (Geneva)  
 Adleman, Marvin I., M. L. A., Harvard U. Prof., Landscape Architecture  
 Agnello, Arthur M., Ph.D., North Carolina State U. Assoc. Prof., Entomology (Geneva)  
 Ahner, Beth A., Ph.D., Massachusetts Institute of Technology. Asst. Prof., Agricultural and Biological Engineering  
 Aist, James R., Ph.D., U. of Wisconsin. Prof., Plant Pathology  
 Albright, Louis D., Ph.D., Cornell U. Prof., Agricultural and Biological Engineering  
 Aldwinckle, Herbert S., Ph.D., U. of London (England). Prof., Plant Pathology (Geneva)  
 Alexander, Martin, Ph.D., U. of Wisconsin. Prof., Soil, Crop, and Atmospheric Sciences  
 Allee, David J., Ph.D., Cornell U. Prof., Agricultural, Resource, and Managerial Economics  
 Altman, Naomi S., Ph.D., Stanford U. Assoc. Prof., Plant Breeding and Biometry  
 Andersen, Robert L., Ph.D., U. of Minnesota. Prof., Horticultural Sciences (Geneva)  
 Anderson, Bruce L., Ph.D., U. of California at Berkeley. Assoc. Prof., Agricultural, Resource, and Managerial Economics  
 Aneshansley, Daniel J., Ph.D., Cornell U. Assoc. Prof., Agricultural and Biological Engineering  
 Appgar, Barbara J., Ph.D., Cornell U. Assoc. Prof., Animal Science  
 Ameson, Phil A., Ph.D., U. of Wisconsin. Assoc. Prof., Plant Pathology  
 Austic, Richard E., Ph.D., U. of California at Davis. Prof., Animal Science  
 Baer, Richard A., Ph.D., Harvard U. Prof., Natural Resources

Bain, Mark B., Ph.D., U. of Massachusetts. Assoc. Prof., Natural Resources  
 Bandler, David K., M.P.S., Cornell U. Prof., Food Science  
 Barbano, David M., Ph.D., Cornell U. Prof., Food Science  
 Bartsch, James A., Ph.D., Purdue U. Assoc. Prof., Agricultural and Biological Engineering  
 Bassuk, Nina L. Ph.D., U. of London (England). Prof., Floriculture and Ornamental Horticulture  
 Batt, Carl A., Ph.D., Rutgers U. Assoc. Prof., Food Science  
 Baugher, Sherene, Ph.D., SUNY Stonybrook. Asst. Prof., Landscape Architecture  
 Bauman, Dale E., Ph.D., U. of Illinois. Prof., Animal Science  
 Baveye, Philippe C., Ph.D., U. of California at Riverside. Assoc. Prof., Soil, Crop, and Atmospheric Sciences  
 Beer, Steven V., Ph.D., U. of California at Davis. Assoc. Prof., Plant Pathology  
 Beermann, Donald H., Ph.D., U. of Wisconsin. Prof., Animal Science  
 Bell, Alan W., Ph.D., U. of Glasgow (Scotland). Prof., Animal Science  
 Bellinder, Robin R., Ph.D., Virginia Polytechnic Inst. and State U. Assoc. Prof., Fruit and Vegetable Science  
 Bergstrom, Gary C., Ph.D., U. of Kentucky. Prof., Plant Pathology  
 Bills, Nelson L., Ph.D., Washington State U. Prof., Agricultural, Resource, and Managerial Economics  
 Bjorkman, Thomas N., Ph.D., Cornell U. Assoc. Prof., Horticultural Sciences (Geneva)  
 Blake, Robert W., Ph.D., North Carolina State U. Prof., Animal Science  
 Boisclair, Yves R., Ph.D., Cornell U. Asst. Prof., Animal Science  
 Boisvert, Richard N., Ph.D., U. of Minnesota. Prof., Agricultural, Resource, and Managerial Economics  
 Boor, Kathryn J., Ph.D., U. of California at Davis. Asst. Prof., Food Science  
 Brady, John W., Jr., Ph.D., SUNY at Stonybrook. Assoc. Prof., Food Science  
 Brake, John R., Ph.D., North Carolina State U. Prof., Agricultural, Resource, and Managerial Economics  
 Broadway, Roxanne M., Ph.D., U. of California at Davis. Assoc. Prof., Entomology (Geneva)  
 Brown, Dan L., Ph.D., Cornell U. Assoc. Prof., Animal Science  
 Brown, David L., Ph.D., U. of Wisconsin. Professor, Rural Sociology  
 Brown, Susan K., Ph.D., U. of California at Davis. Assoc. Prof., Horticultural Sciences (Geneva)  
 Bryant, Ray B., Ph.D., Purdue U. Assoc. Prof., Soil, Crop, and Atmospheric Sciences  
 Burr, Thomas J., Ph.D., U. of California at Berkeley. Prof., Plant Pathology (Geneva)  
 Butler, Walter R., Ph.D., Purdue U. Prof., Animal Science  
 Calderone, Nicholas W., Ph.D., Ohio State U. Asst. Prof., Entomology  
 Carlsen, William S., Ph.D., Stanford U. Assoc. Prof., Education  
 Casella, George, Ph.D., Purdue U. Prof., Plant Breeding and Biometry  
 Castillo-Chavez, Carlos, Ph.D., U. of Wisconsin. Assoc. Prof., Plant Breeding and Biometry  
 Chapman, Lewis D., Ph.D., U. of California at Berkeley. Prof., Agricultural, Resource, and Managerial Economics

Chase, Larry E., Ph.D., Pennsylvania State U. Assoc. Prof., Animal Science  
 Cherney, Jerome H., Ph.D., U. of Minnesota. Prof., Soil, Crop, and Atmospheric Sciences  
 Christy, Ralph D., Ph.D., Michigan State U. Prof., Agricultural, Resource, and Managerial Economics  
 Churchill, Gary A., Ph.D., U. of Washington. Asst. Prof., Plant Breeding and Biometry  
 Coffman, W. Ronnie, Ph.D., Cornell U. Prof., Plant Breeding and Biometry  
 Colle, Royal D., Ph.D., Cornell U. Prof., Communication  
 Collmer, Alan R., Ph.D., Cornell U. Prof., Plant Pathology  
 Colucci, Stephen J., Ph.D., SUNY. Assoc. Prof., Soil, Crop, and Atmospheric Sciences  
 Confrey, Jere, Ph.D., Cornell U. Assoc. Prof., Education  
 Conneman, George J., Ph.D., Pennsylvania State U. Prof., Agricultural, Resource, and Managerial Economics  
 Conrad, Jon M., Ph.D., U. of Wisconsin. Prof., Agricultural, Resource, and Managerial Economics  
 Contreras, Martha, Ph.D., U. of California at Riverside. Asst. Prof., Plant Breeding and Biometry  
 Cook, Kerry H., Ph.D., North Carolina State U. Assoc. Prof., Soil, Crop, and Atmospheric Sciences  
 Cooke, J. Robert, Ph.D., North Carolina State U. Prof., Agricultural and Biological Engineering  
 Cox, William J., Ph.D., Oregon State U. Assoc. Prof., Soil, Crop, and Atmospheric Sciences  
 Creasy, Leroy L., Ph.D., U. of California at Davis. Prof., Fruit and Vegetable Science  
 Currie, W. Bruce, Ph.D., Macquarie U. (Australia) Prof., Animal Science  
 Danforth, Bryan N., Ph.D., U. of Kansas. Asst. Prof., Entomology  
 Datta, Ashim K., Ph.D., U. of Florida. Assoc. Prof., Agricultural and Biological Engineering  
 Davis, Paula M., Ph.D., Iowa State U. Asst. Prof., Entomology  
 Decker, Daniel J., Ph.D., Cornell U. Assoc. Prof., Natural Resources  
 DeGloria, Stephen D., Ph.D., U. of California at Berkeley. Assoc. Prof., Soil, Crop, and Atmospheric Sciences  
 de Gorter, Harry, Ph.D., U. of California at Berkeley. Assoc. Prof., Agricultural, Resource, and Managerial Economics  
 Delaney, Terrence, Ph.D., U. of Washington. Asst. Prof., Plant Pathology  
 Derksen, Richard C., Ph.D., U. of Illinois. Asst. Prof., Agricultural and Biological Engineering  
 Deshler, J. David, Ed.D., U. of California at Los Angeles. Assoc. Prof., Education  
 Dillard, Helene R., Ph.D., U. of California at Berkeley. Assoc. Prof., Plant Pathology (Geneva)  
 Dunn, James A., Ph.D., U. of Michigan. Prof., Education  
 Durst, Richard A., Ph.D., Massachusetts Institute of Technology. Prof., Food Science and Technology (Geneva)  
 Duxbury, John M., Ph.D., U. of Birmingham (England). Prof., Soil, Crop, and Atmospheric Sciences  
 Earle, Elizabeth D., Ph.D., Harvard U. Prof., Plant Breeding and Biometry  
 Eberts, Paul R., Ph.D., U. of Michigan. Prof., Rural Sociology  
 Eckenrode, Charles J., Jr., Ph.D., U. of Wisconsin. Prof., Entomology (Geneva)

- Ellerbrock, LeRoy A., Ph.D., Cornell U. Assoc. Prof., Fruit and Vegetable Science
- Erickson, Eugene C., Ph.D., Michigan State U. Prof., Rural Sociology
- Everett, Robert W., Ph.D., Michigan State U. Prof., Animal Science
- Ewert, D. Merrill, Ph.D., U. of Wisconsin. Assoc. Prof., Education
- Fahey, Timothy J., Ph.D., U. of Wyoming. Prof., Natural Resources
- Feldman, Shelley, Ph.D., U. of Connecticut. Assoc. Prof., Rural Sociology
- Fernandes, Erick C. M., Ph.D., North Carolina State U. Asst. Prof., Soil, Crop and Atmospheric Sciences
- Fick, Gary W., Ph.D., U. of California at Davis. Prof., Soil, Crop, and Atmospheric Sciences
- Figueroa, Enrique E., Ph.D., U. of California at Davis. Assoc. Prof., Agricultural, Resource, and Managerial Economics
- Fiori, Bart J., Ph.D., Cornell U. Assoc. Prof., Entomology (Geneva)
- Forsline, Philip L., M.S., U. of Minnesota. Asst. Prof., Horticultural Sciences (Geneva)
- Fox, Danny G., Ph.D., Ohio State U. Prof., Animal Science
- Francis, Joe D., Ph.D., U. of Missouri. Assoc. Prof., Rural Sociology
- Fry, William E., Ph.D., Cornell U. Prof., Plant Pathology
- Galton, David M., Ph.D., Ohio State U. Prof., Animal Science
- Gavin, Thomas A., Ph.D., Oregon State U. Assoc. Prof., Natural Resources
- Gay, Geraldine K., Ph.D., Cornell U. Assoc. Prof., Communication
- Gebremedhin, Kifle G., Ph.D., U. of Wisconsin. Prof., Agricultural and Biological Engineering
- Geisler, Charles C., Ph.D., U. of Wisconsin. Prof., Rural Sociology
- German, Gene A., Ph.D., Cornell U. Prof., Agricultural, Resource, and Managerial Economics
- Gilbert, Cole, Ph.D. U. of Kansas. Asst. Prof., Entomology
- Gillett, James W., Ph.D., U. of California at Berkeley. Prof., Natural Resources
- Glasgow, Nina, Ph.D., U. of Illinois. Asst. Prof., Rural Sociology
- Glynn, Carroll, Ph.D., U. of Wisconsin. Assoc. Prof., Communication
- Gonsalves, Dennis, Ph.D., U. of California at Davis. Prof., Plant Pathology (Geneva)
- Good, George L., Ph.D., Cornell U. Prof., Floriculture and Ornamental Horticulture
- Gorewit, Ronald C., Ph.D., Michigan State U. Prof., Animal Science
- Gottfried, Herbert W., Ph.D., Ohio U. Prof., Landscape Architecture
- Gravani, Robert B., Ph.D., Cornell U. Prof., Food Science
- Gray, Stewart M., Ph.D., North Carolina State U. Assoc. Prof., Plant Pathology
- Grunes, David L., Ph.D., U. of California at Berkeley. Prof., Soil, Crop, and Atmospheric Sciences
- Gurak, Douglas T., Ph.D., U. of Wisconsin. Prof., Rural Sociology
- Hahn, Russell R., Ph.D., Texas A. & M. U. Assoc. Prof., Soil, Crop, and Atmospheric Sciences
- Haith, Douglas A., Ph.D., Cornell U. Prof., Agricultural and Biological Engineering
- Hajek, Ann E., Ph.D., U. of California at Berkeley. Asst. Prof., Entomology
- Haller, Emil J., Ph.D., U. of Chicago. Prof., Education
- Halseth, Donald E., Ph.D., Cornell U. Assoc. Prof., Fruit and Vegetable Science
- Hang, Yong D., Ph.D., McGill U. (Canada). Prof., Food Science and Technology (Geneva)
- Harman, Gary E., Ph.D., Oregon State U. Prof., Horticultural Sciences (Geneva)
- Harwood, Edward D., Ph.D., U. of Wisconsin-Madison. Assoc. Prof., Cooperative Extension Administration
- Hedlund, Dalva E., Ph.D., Colorado State U. Assoc. Prof., Education
- Henick-Kling, Thomas, Ph.D., U. of Adelaide (Australia). Assoc. Prof., Food Science and Technology (Geneva)
- Hicks, James R., Ph.D., U. of Maryland. Assoc. Prof., Fruit and Vegetable Science
- Hintz, Harold F., Ph.D., Cornell U. Prof., Animal Science
- Hirschl, Thomas A., Ph.D., U. of Wisconsin. Assoc. Prof., Rural Sociology
- Hoch, Harvey, Ph.D., U. of Wisconsin. Prof., Plant Pathology (Geneva)
- Hoffmann, Michael P., Ph.D., U. of California. Assoc. Prof., Entomology
- Horrigan, Paula H., M.L.A., Cornell U. Asst. Prof., Landscape Architecture
- Horst, R. Kenneth, Ph.D., Ohio U. Prof., Plant Pathology
- Hotchkiss, Joseph H., Ph.D., Oregon State U. Prof., Food Science
- Hrazdina, Geza, Ph.D., Eidg. Technische Hochschule at Zürich (Switzerland). Prof., Food Science and Technology (Geneva)
- Hudler, George W., Ph.D., Colorado State U. Assoc. Prof., Plant Pathology
- Hunter, James E., Ph.D., U. of New Hampshire. Prof., Plant Pathology (Geneva)
- Hunter, Jean B., D.En.Sc., Columbia U. Assoc. Prof., Agricultural and Biological Engineering
- Irwin, Lynne H., Ph.D., Texas A & M U. Assoc. Prof., Agricultural and Biological Engineering
- Jacobson, Jay S., Ph.D., Columbia U. Assoc. Prof., Natural Resources
- Jewell, William J., Ph.D., Stanford U. Prof., Agricultural and Biological Engineering
- Johnson, Patricia A., Ph.D., Cornell U. Assoc. Prof., Animal Science
- Kaiser, Harry M., Ph.D., U. of Minnesota. Assoc. Prof., Agricultural, Resource, and Managerial Economics
- Kalter, Robert J., Ph.D., U. of Wisconsin. Prof., Agricultural, Resource, and Managerial Economics
- Keshavarz, Kavous, Ph.D., U. of Georgia. Assoc. Prof., Animal Science
- Khan, Anwar A., Ph.D., U. of Chicago. Prof., Horticultural Sciences (Geneva)
- Knapp, Warren W., Ph.D., U. of Wisconsin. Prof., Soil, Crop, and Atmospheric Sciences
- Knipple, Douglas C., Ph.D., Cornell U. Assoc. Prof., Entomology (Geneva)
- Knoblauch, Wayne A., Ph.D., Michigan State U. Prof., Agricultural, Resource, and Managerial Economics
- Knuth, Barbara A., Ph.D., Virginia Polytechnical Inst. and State U. Assoc. Prof., Natural Resources
- Kochian, Leon V., Ph.D., U. of California at Davis. Assoc. Prof., Soil, Crop, and Atmospheric Sciences
- Koeller, Wolfram, Ph.D., Phillips-University-Marburg (Germany). Assoc. Prof., Plant Pathology (Geneva)
- Krall, Daniel W., M.L.A. Cornell U. Assoc. Prof., Landscape Architecture
- Krasny, Marianne E., Ph.D., U. of Washington. Assoc. Prof., Natural Resources
- Kritz, Mary M., Ph.D., U. of Wisconsin. Assoc. Prof., Rural Sociology
- Krueger, Charles C., Ph.D., U. of Minnesota. Prof., Natural Resources
- Kyle, Margaret M., Ph.D., Cornell U. Asst. Prof., Plant Breeding and Biometry
- Kyle, Steven C., Ph.D., Harvard U. Assoc. Prof., Agricultural, Resource, and Managerial Economics
- Lacy, William B., Ph.D., U. of Michigan. Prof., Cooperative Extension Administration
- LaDue, Eddy L., Ph.D., Michigan State U. Prof., Agricultural, Resource, and Managerial Economics
- Lakso, Alan N., Ph.D., U. of California at Davis. Prof., Horticultural Sciences (Geneva)
- Lambert, Robert J., Jr., M.S., U. of Michigan. Prof., Floriculture and Ornamental Horticulture
- Langhans, Robert W., Ph.D., Cornell U. Prof., Floriculture and Ornamental Horticulture
- Lassoie, James P., Ph.D., U. of Washington. Prof., Natural Resources
- Lawless, Harry T., Ph.D., Brown U. Assoc. Prof., Food Science
- Ledford, Richard A., Ph.D., Cornell U. Prof., Food Science
- Lee, Chang Y., Ph.D., Utah State U. Prof., Food Science and Technology (Geneva)
- Lee, David R., Ph.D., U. of Wisconsin. Assoc. Prof., Agricultural, Resource, and Managerial Economics
- Lei, Xingen, Ph.D., Michigan State U. Asst. Prof., Animal Science
- Lesser, William H., Ph.D., U. of Wisconsin. Prof., Agricultural, Resource, and Managerial Economics
- Lewenstein, Bruce V., Ph.D., U. of Pennsylvania. Assoc. Prof., Communication
- Liebherr, James K., Ph.D., U. of California at Berkeley. Assoc. Prof., Entomology
- Lorbeer, James W., Ph.D., U. of California at Berkeley. Prof., Plant Pathology
- Loria, Rosemary, Ph.D., Michigan State U. Assoc. Prof., Plant Pathology
- Lund, Daryl B., Ph.D., U. of Wisconsin. Prof., Food Science
- Lyson, Thomas A., Ph.D., Michigan State U. Prof., Rural Sociology
- McBride, Murray B., Ph.D., Michigan State U. Prof., Soil, Crop, and Atmospheric Sciences
- McCouch, Susan, Ph.D., Cornell U. Asst. Prof., Plant Breeding and Biometry
- McCulloch, Charles E., Ph.D., Cornell U. Prof., Plant Breeding and Biometry
- McDonald, Daniel, Ph.D., U. of Wisconsin. Assoc. Prof., Communication
- McFerson, James R., Ph.D., U. of Wisconsin. Asst. Prof., Horticultural Sciences (Geneva)
- McGrath, Margaret T., Ph.D., Pennsylvania State U. Assoc. Prof., Plant Pathology
- McLaughlin, Edward W., Ph.D., Michigan State U. Assoc. Prof., Agricultural, Resource, and Managerial Economics
- McLellan, Mark R., Ph.D., Michigan State U. Assoc. Prof., Food Science and Technology (Geneva)
- McMichael, Philip D., Ph.D., SUNY Binghamton. Prof., Rural Sociology
- McNeil, Richard J., Ph.D., U. of Michigan. Prof., Natural Resources
- Malecki, Richard A., Ph.D., U. of Missouri. Assoc. Prof., Natural Resources
- Merwin, Ian A., Ph.D., Cornell U. Assoc. Prof., Fruit and Vegetable Science
- Milgroom, Michael G., Ph.D., Cornell U. Assoc. Prof., Plant Pathology
- Miller, Dennis D., Ph.D., Cornell U. Prof., Food Science
- Milligan, Robert A., Ph.D., U. of California at Davis. Prof., Agricultural, Resource, and Managerial Economics

- Millman, Jason, Ph.D., U. of Michigan. Prof., Education
- Moen, Aaron N., Ph.D., U. of Minnesota. Prof., Natural Resources
- Monk, David H., Ph.D., U. of Chicago. Prof., Education
- Mount, Timothy D., Ph.D., U. of California at Berkeley. Prof., Agricultural, Resource, and Managerial Economics
- Mower, Robert G., Ph.D., Cornell U. Prof., Floriculture and Ornamental Horticulture
- Mt. Pleasant, Jane, Ph.D., North Carolina State U. Assoc. Prof., Soil, Crop, and Atmospheric Sciences
- Mudge, Kenneth W., Ph.D., Washington State U. Assoc. Prof., Floriculture and Ornamental Horticulture
- Mulvaney, Steven J., Ph.D., Cornell U. Assoc. Prof., Food Science
- Mutschler, Martha A., Ph.D., U. of Wisconsin. Prof., Plant Breeding and Biometry
- Neal, Joseph C., Ph.D., North Carolina State U. Assoc. Prof., Floriculture and Ornamental Horticulture
- Nelson, Eric B., Ph.D., Ohio State U. Assoc. Prof., Plant Pathology
- Norvell, Wendell A., Ph.D., Colorado State U. Assoc. Prof., Soil, Crop, and Atmospheric Sciences
- Novakovic, Andrew M., Ph.D., Purdue U. Prof., Agricultural, Resource, and Managerial Economics
- Nyrop, Jan P., Ph.D., Michigan State U. Assoc. Prof., Entomology (Geneva)
- Obendorf, Ralph L., Ph.D., U. of California at Davis. Prof., Soil, Crop, and Atmospheric Sciences
- Oltenuacu, Elizabeth A., Ph.D., U. of Minnesota. Assoc. Prof., Animal Science
- Oltenuacu, Pascal A., Ph.D., U. of Minnesota. Prof., Animal Science
- Ostman, Ronald E., Ph.D., U. of Minnesota. Prof., Communication
- Palukaitis, Peter F., Ph.D., U. of Adelaide (Australia). Assoc. Prof., Plant Pathology
- Pardee, William D., Ph.D., Cornell U. Prof., Plant Breeding and Biometry
- Parks, John E., Ph.D., Virginia Polytechnic Inst. Assoc. Prof., Animal Science
- Parlange, Jean-Yves, Ph.D., Brown U. Prof., Agricultural and Biological Engineering
- Patrican, Lisa A., Ph.D., U. of Wisconsin. Asst. Prof., Entomology
- Peckarsky, Barbara L., Ph.D., U. of Wisconsin. Prof., Entomology
- Pell, Alice N., Ph.D., U. of Vermont. Assoc. Prof., Animal Science
- Petrovic, A. Martin, Ph.D., Michigan State U. Prof., Floriculture and Ornamental Horticulture
- Peverly, John H., Ph.D., U. of Illinois. Assoc. Prof., Soil, Crop, and Atmospheric Sciences
- Pfeffer, Max, Ph.D., U. of Wisconsin. Assoc. Prof., Rural Sociology
- Pimentel, David, Ph.D., Cornell U. Prof., Entomology
- Pitt, Ronald E., Ph.D., Cornell U. Prof., Agricultural and Biological Engineering
- Poe, Gregory, Ph.D., U. of Wisconsin. Asst. Prof., Agricultural, Resource, and Managerial Economics
- Poleman, Thomas T., Ph.D., Stanford U. Prof., Agricultural, Resource, and Managerial Economics
- Pollak, E. John, Ph.D., Iowa State U. Prof., Animal Science
- Pool, Robert M., Ph.D., Cornell U. Prof., Horticultural Sciences (Geneva)
- Posner, George J., Ed.D., SUNY at Albany. Prof., Education
- Price, Hugh C., Ph.D., Michigan State U. Prof., Horticultural Sciences (Geneva)
- Pritts, Marvin P., Ph.D., Michigan State U. Assoc. Prof., Fruit and Vegetable Science
- Quaas, Richard L., Ph.D., Colorado State U. Prof., Animal Science
- Quirk, Susan M., Ph.D., Cornell U. Asst. Prof., Animal Science
- Rakow, Donald A., Ph.D., Cornell U. Assoc. Prof., Floriculture and Ornamental Horticulture
- Raman, Kandukuri, Ph.D., U. of Reading. Prof., Plant Breeding and Biometry
- Ranney, Christine K., Ph.D., U. of California at Davis. Assoc. Prof., Agricultural, Resource and Managerial Economics
- Rao, M. Anandha, Ph.D., Ohio State U. Prof., Food Science and Technology (Geneva)
- Regenstein, Joe M., Ph.D., Brandeis U. Prof., Food Science
- Reid, W. Shaw, Ph.D., Michigan State U. Prof., Soil, Crop, and Atmospheric Sciences
- Reiners, Stephen, Ph.D., Ohio State U. Asst. Prof., Horticultural Sciences (Geneva)
- Reisch, Bruce, Ph.D., U. of Wisconsin. Prof., Horticultural Sciences (Geneva)
- Reissig, William H., Ph.D., Oregon State U. Prof., Entomology (Geneva)
- Richmond, Milo E., Ph.D., U. of Missouri. Assoc. Prof., Natural Resources
- Riha, Susan, Ph.D., Washington State U. Prof., Soil, Crop, and Atmospheric Sciences
- Ripple, Richard E., Ph.D., U. of Wisconsin. Prof., Education
- Rizvi, Syed S., Ph.D., Ohio State. Prof., Food Science
- Robinson, Richard W., Ph.D., Cornell U. Prof., Horticultural Sciences (Geneva)
- Robinson, Terence L., Ph.D., Washington State U. Assoc. Prof., Horticultural Sciences (Geneva)
- Roelofs, Wendell L., Ph.D., Indiana U. Prof., Entomology (Geneva)
- Rosenberger, David A., Ph.D., Michigan State U. Assoc. Prof., Plant Pathology (Geneva)
- Rutz, Donald A., Ph.D., North Carolina State U. Prof., Entomology
- Sanderson, John P., Ph.D., U. of California at Riverside. Prof., Entomology
- Sanford, John C., Ph.D., U. of Wisconsin. Assoc. Prof., Horticultural Sciences (Geneva)
- Scherer, Clifford W., Ph.D., U. of Wisconsin. Assoc. Prof., Communication
- Schneider, Rebecca, Ph.D., Cornell U. Asst. Prof., Natural Resources
- Schrader, Dawn E., Ph.D., Harvard U. Assoc. Prof., Education
- Schulze, William D., Ph.D., U. of California at Riverside. Prof., Agricultural, Resource, and Managerial Economics
- Schwager, Steven J., Ph.D., Yale U. Assoc. Prof., Plant Breeding and Biometry
- Schwartz, Donald F., Ph.D., Michigan State U. Prof., Communication
- Scott, Jeffrey G., Ph.D., U. of California at Berkeley. Assoc. Prof., Entomology
- Scott, Norman R., Ph.D., Cornell U. Prof., Agricultural and Biological Engineering
- Seem, Robert C., Ph.D., Pennsylvania State U. Assoc. Prof., Plant Pathology (Geneva)
- Setter, Timothy L., Ph.D., U. of Minnesota. Assoc. Prof., Soil, Crop, and Atmospheric Sciences
- Shanahan, James E., Ph.D., U. of Massachusetts-Amherst. Asst. Prof., Communication
- Shapiro, Michael A., Ph.D., U. of Wisconsin. Assoc. Prof., Communication
- Shelton, Anthony M., Ph.D., U. of California at Riverside. Prof., Entomology (Geneva)
- Shields, Elson J., Ph.D., U. of Wisconsin. Assoc. Prof., Entomology
- Siebert, Karl J., Ph.D., Pennsylvania State U. Prof., Food Science and Technology (Geneva)
- Sieczka, Joseph B., M.S., Cornell U. Assoc. Prof., Fruit and Vegetable Science
- Sinclair, Wayne A., Ph.D., Cornell U. Prof., Plant Pathology
- Slack, Steven A., Ph.D., U. of California at Davis. Prof., Plant Pathology
- Smith, Margaret E., Ph.D., Cornell U. Assoc. Prof., Plant Breeding and Biometry
- Smith, R. David, Ph.D., Cornell U. Assoc. Prof., Animal Science
- Soderlund, David M., Ph.D., U. of California at Berkeley. Prof., Entomology (Geneva)
- Sorrells, Mark E., Ph.D., U. of Wisconsin. Prof., Plant Breeding and Biometry
- Steele, Roger E., Ph.D., Michigan State U. Asst. Prof., Education
- Steenhuis, Tammo S., Ph.D., U. of Wisconsin. Prof., Agricultural and Biological Engineering
- Steffens, John C., Ph.D., U. of Virginia. Assoc. Prof., Plant Breeding and Biometry
- Steponkus, Peter L., Ph.D., Purdue U. Prof., Soil, Crop, and Atmospheric Sciences
- Stepp, Pamela L., Ph.D., Cornell U. Asst. Prof., Communication
- Stiles, Warren C., Ph.D., Pennsylvania State U. Prof., Fruit and Vegetable Science
- Stover, Eddie W., Ph.D., U. of Maryland. Asst. Prof., Horticultural Science (Geneva)
- Straub, Richard W., Ph.D., U. of Missouri. Prof., Entomology (Geneva)
- Streeter, Deborah H., Ph.D., U. of Wisconsin. Assoc. Prof., Agricultural, Resource, and Managerial Economics
- Strike, Kenneth A., Ph.D., Northwestern U. Prof., Education
- Stycos, J. Mayone, Ph.D., Columbia U. Prof., Rural Sociology
- Sutphin, H. Dean, Ph.D., Ohio State U. Assoc. Prof., Education
- Tanksley, Steven D. Ph.D., U. of California at Davis. Prof., Plant Breeding and Biometry
- Tauber, Maurice J., Ph.D., U. of California at Berkeley. Prof., Entomology
- Tauer, Loren W., Ph.D., Iowa State U. Prof., Agricultural, Resource, and Managerial Economics
- Taylor, Alan G., Ph.D., Oklahoma State U. Assoc. Prof., Horticultural Sciences (Geneva)
- Tennessen, Daniel J., Ph.D., U. of Wisconsin. Asst. Prof., Floriculture and Ornamental Horticulture
- Thonney, Michael L., Ph.D., U. of Minnesota. Prof., Animal Science
- Timmons, Michael B., Ph.D., Cornell U. Prof., Agricultural and Biological Engineering
- Tingey, Ward M., Ph.D., U. of Arizona. Prof., Entomology
- Tomek, William G., Ph.D., U. of Minnesota. Prof., Agricultural, Resource, and Managerial Economics
- Topoleski, Leonard D., Ph.D., Purdue U. Prof., Fruit and Vegetable Science
- Trancik, Roger T., M.L.A., Harvard U. Prof., Landscape Architecture
- Trowbridge, Peter J., M.L.A., Harvard U. Prof., Landscape Architecture
- Trumbull, Deborah J., Ph.D., U. of Illinois. Assoc. Prof., Education
- Turgeon, B. Gillian, Ph.D., U. of Dayton. Assoc. Prof., Plant Pathology
- VanAmburgh, Michael E., Ph.D., Cornell U. Asst. Prof., Animal Science

- VanCampen, Darrell R., Ph.D., North Carolina State U. Assoc. Prof., Animal Science
- vanEs, Harold M., Ph.D., North Carolina State U. Assoc. Prof., Soil, Crop, and Atmospheric Sciences
- Via, Sara, Ph.D., Duke U. Assoc. Prof., Entomology
- Viands, Donald R., Ph.D., U. of Minnesota. Prof., Plant Breeding and Biometry
- Villani, Michael G., Ph.D., North Carolina State U. Assoc. Prof., Entomology (Geneva)
- Wagenet, Robert J., Ph.D., U. of California at Davis. Prof., Soil, Crop, and Atmospheric Sciences
- Walker, Larry P., Ph.D., Michigan State U. Prof., Agricultural and Biological Engineering
- Walter, Michael F., Ph.D., U. of Wisconsin. Prof., Agricultural and Biological Engineering
- Walter, Reginald H., Ph.D., U. of Massachusetts. Prof., Food Science and Technology (Geneva)
- Watkins, Christopher B., Rutgers U. Assoc. Prof., Fruit and Vegetable Science
- Weeden, Norman F., Ph.D., U. of California at Davis. Assoc. Prof., Horticultural Sciences (Geneva)
- Weiler, Thomas C., Ph.D., Cornell. Prof., Floriculture and Ornamental Horticulture
- Welch, Ross M., Ph.D., U. of California at Davis. Prof., Soil, Crop, and Atmospheric Sciences
- Wheeler, Quentin D., Ph.D., Ohio State U. Prof., Entomology
- White, Gerald B., Ph.D., Pennsylvania State U. Prof., Agricultural, Resource, and Managerial Economics
- White, Shirley A., Ph.D., Michigan State U. Prof., Communication
- Whitlow, Thomas H., Ph.D., U. of California at Davis. Asst. Prof., Floriculture and Ornamental Horticulture
- Wien, Hans C., Ph.D., Cornell U. Prof., Fruit and Vegetable Science
- Wilcox, Wayne F., Ph.D., U. of California at Davis. Assoc. Prof., Plant Pathology (Geneva)
- Wilkins, Bruce T., Ph.D., Cornell U. Prof., Natural Resources
- Wilks, Daniel S., Ph.D., Oregon State U. Assoc. Prof., Soil, Crop, and Atmospheric Sciences
- Willet, Lois S., Ph.D., U. of California at Davis. Assoc. Prof., Agricultural, Resource, and Managerial Economics
- Williams, Linda, Ph.D., Brown U. Asst. Prof., Rural Sociology
- Wolfe, David W., Ph.D., U. of California at Davis. Assoc. Prof., Fruit and Vegetable Science
- Yarbrough, J. Paul, Ph.D., Iowa State U. Prof., Communication
- Yavitt, Joseph B., Ph.D., U. of Wyoming. Asst. Prof., Natural Resources
- Yoder, Olen C., Ph.D., Michigan State U. Prof., Plant Pathology
- Zaitlin, Milton, Ph.D., U. of California at Los Angeles. Prof., Plant Pathology
- Zitter, Thomas A., Ph.D., Michigan State U. Prof., Plant Pathology
- Zobel, Richard W. Ph.D., U. of California at Davis. Assoc. Prof., Soil, Crop, and Atmospheric Sciences



